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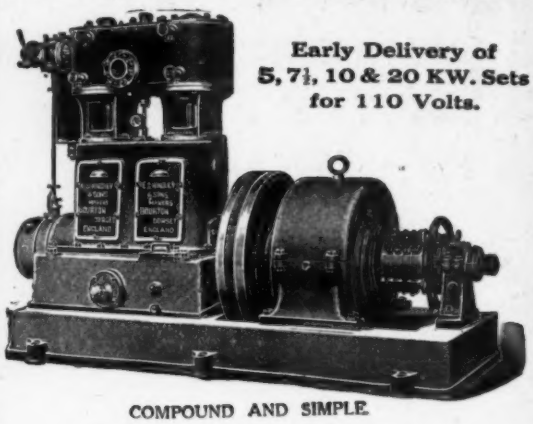

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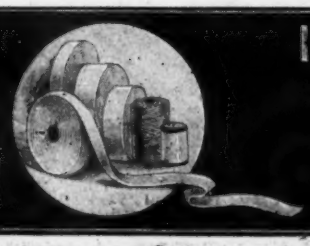

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VOL. XC. FEBRUARY 3, 1922. No. 2,306.

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Vol. XC.] CONTENTS: February 3rd, 1922. [No. 2,306.

	Page
A Contract and Confidence	145
Railway Electrification	146
The Industrial Future of Australia	146
The Exports Credits Scheme	147
Petty Tyranny	147
Compensation for Loss of Employment	147
An Electrically-driven Cement Works (*illus.*)	148
Localising a Fault of Low or High Resistance in a Submarine Cable when the Conductor is not Broken, by R. Rymer-Jones (*illus.*)	150
The Selling of Electrical Appliances	152
Imperial Wireless Telegraphy	153
Legal	154
New Electrical Devices, Fittings, and Plant (*illus.*)	156
Correspondence—	
The Utilisation of Waste Heat	157
The Durability of Lead-covered Wire	157
Change-over from d.c. to a.c. Supply	158
"The Magnetic Screening of Cables"	158
A Notice to Callers	158
Correction	158
The Stiffness of Poles	158
Proposed Emigration	159
Charging for Services	159
Business Notes	160
Notes	166
City Notes	169
Stocks and Shares	170
The Physical Society of London (*illus.*) (*continued*)	171
The Electrical Development of Outlying Districts	173
The Electrification of Main-line Railways	174
Induction-type Synchronous Motors	176
Industrial Research	177
Reviews	178
New Patents	180
Published Specifications	180
Contractors' Column	...Advertisement page xxviii

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A CONTRACT AND CONFIDENCE.

THE placing of an individual contract is not the subject upon which one generally cares to base a leading article, but there may be occasions when a single contract possesses such significance as to justify expressions of gratification from the standpoint of a whole industry. We do not think we exaggerate when we say that the placing of a contract with the Metropolitan-Vickers Company for an important part of the electrification of the railway systems of the Union of South Africa is such an event.

The news comes at the psychological moment. First, it will help to undo some of the damage done to British electrical engineering prestige by the publicly-made suggestion that we should let Germany undertake the electrification of our railways in the United Kingdom as a part payment of reparations. Secondly, it comes at a time when the electrical industry is ready to welcome large business which will ensure continuous employment for British workpeople, for the works are in too many cases engaged on the execution of old orders, and new ones are not coming in as they should do to provide future work. Thirdly, the contract is for a British Colony, and is an example to other Colonies and Dependencies to place their orders for execution in the factories of the Homeland; it is the second case within a couple of years of British Empire railway electrification being placed here, the other being the New Zealand success of the English Electric Co., Ltd. Further, it is very acceptable just now, because, in spite of rates of exchange and other adverse circumstances, it has been secured to us in the face of very keen European and American competition; and still further because it follows on the heels of several large American successes in Chile and the Far East.

Yet another gratifying point in connection with the matter, considered from the standpoint of our electrical trade abroad, is the suggestion that German electrical influence in South Africa is not now so discouraging a factor as it once was. Some years ago the electrical equipment of the Rand was allowed, owing to the failure of British financiers to back up British industry, to become altogether too Teutonic to please any of us. We hope that the railway electrification contract now placed will possess an advertising value for British prestige in all parts of South Africa. It is not an event to be hidden as a light under a bushel. Let the event shout itself abroad through all the legitimate media for propaganda!

So much for the electrical considerations arising out of this contract. It is an event which may at once be both a cause for optimism and a sign to justify that optimism. Electrical men may justly regard it as the beginning of the revival which is so sure to come. It

is but a foretaste of the larger and better fruit that British railway electrification should shortly yield; but is it any less a sign that the world is gradually but surely going to find its way through its difficulties back to economic and industrial stability and advance?

British engineering firms are finding it possible, when conditions are so much against them, to quote competitively against foreign rivals. At the same time that the South African result was being referred to in the daily Press, other gratifying announcements of a similar nature were also appearing. For instance, a pumping machinery contract (for Littleton) was booked by a British firm in competition with Swiss, Dutch, and French firms; and there was a prospect of iron and steel works in the Sheffield district receiving very large orders for railway rails. Later dispatches report the placing of a £500,000 contract for grain elevators for the Government of South Africa with an English firm.

In years gone by when this old country has been down in the Slough of Despond through world-wide economic and financial depression, we have watched out for any little signs that appeared on the horizon that confidence was beginning to return. It was not long before confidence in one country begat confidence in another, and quicker than one had dared to anticipate we were well on the rise to a boom in trade. The difficulties of the last eight years have been more serious than we ever faced before, so it is less easy to form a reliable judgment, but we believe that confidence is really returning, and we may be permitted to quote in support of our opinion the statement made by Sir Henry Goschen at the meeting of the National Provincial and Union Bank. He referred to "some break in the clouds of depression," and showed that the banking community considers that we have passed through the worst of our troubles. In other words, the corner has been turned. A shipping director the other day pooh-poohed the hopes of the optimists, and asked where there was evidence of improvement. *That* is the very spirit which kills optimism in some people and prevents the return of confidence, the spirit of adventure, the revival of trade, and the lessening of unemployment. We think there are grounds for optimism both electrically and generally, and not the least helpful factor in the situation is the hope that some relief is coming from the throttling grip of taxation on both industries and individuals. If we go about our several ways doing our utmost to encourage the spirit of confidence, we shall witness the realisation of our hopes more speedily than if we sit down and grouse and wait for something to turn up.

Railway Electrification.

The valuable precedent set in the case of the Severn Tidal Power Scheme has been followed by a second notable conference of members of the three great engineering Institutions at Birmingham, the subject being one with which they are all intimately concerned—namely, the electrification of main-line railways, than which there is no more important topic before the engineering industry at the moment. A report of the debate appears elsewhere in this issue, and it is striking to observe the consensus of opinion of the speakers in favour of the proposition—provided that financial considerations could be satisfactorily dealt with. That, indeed, is the crux of the whole question; and it is bound up with the state of trade in general in this country, for it was shown that under existing conditions the steam-operated railways were only carrying about 80 per cent. of their pre-war traffic, so that it could not be said that the lines were congested.

On the other hand, stress was laid on the great economies that resulted from the adoption of electric traction, and on the fact that electrification brought additional traffic, which has been so convincingly exemplified in the case of the suburban railways that have been electrified.

It is indeed remarkable in how many applications of electricity a number of wholly unforeseen advantages have come to light, immensely strengthening the case for its adoption. For instance, in textile mills, the steadiness of the drive has enabled a larger output to be obtained, more than repaying the cost of conversion; the adoption of electric lighting prolongs the useful life of decorations, curtains, &c.; electric cooking makes meat go farther, a most important consideration for restaurateurs; and in the case before us, quite a long list of advantages has been drawn up, by no one more ably than by Sir Vincent Raven, many of which could hardly have been guessed at before practical experience had been gained. One point upon which emphasis was laid by several speakers at the joint meeting was the increased capacity of existing bridges, and the possibility of improving the design of new ones, brought about by electric traction.

There is no doubt that this timely discussion will prove fruitful in hastening the inauguration of schemes of electrification, and it is gratifying to record that the Southern group of railways—the L. & S.W., the L.B. & S.C., and the S.E. Railways—is contemplating an early commencement; a committee has been appointed by the Ministry of Transport to consider the possibility of adopting a standard scheme for these companies, which are all desirous of employing different methods. The Metropolitan and Great Central Railways (jointly), the Great Eastern, and the North-Eastern also have important projects under consideration, which have been summarised in our pages, and the Dominions are placing large orders in this country for electric railway plant.

The Industrial Future of Australia.

The exhibition of Australian produce and manufactures that is now in being at Australia House, London, is well worthy of a visit. It was declared open last week by Sir Joseph Cook, the new High Commissioner, in a most felicitous speech, in which, with quiet but arresting conviction, he foretold the wonderful industrial and trading future that lies before the Commonwealth. It is true that few of the exhibits make a direct appeal to the engineer, but, as Sir Joseph explained, it is impossible to give a live exhibit in so small a space of locomotives, ships, and other large lines that now have an important place in Australia's manufacturing and constructional achievements. The exhibition makes its appeal to the electrical engineer as a citizen of the British Empire rather than as a member of a specialised vocation, though in matters electrical Australasia is already a fairly considerable manufacturer as well as being a market for Home productions. We are afraid that we have got so accustomed to regarding Australia as a market for our goods that we are apt to belittle her position as a community exporting its own manufactures. Yet geographically she is situated within easy reach of hosts of millions of prospective purchasers—Pacific peoples who are in want of products which the British people can supply, whether they produce them in the British Isles or in that vast island which is as extensive as the whole of Europe. As overseas suppliers, our kinsmen recognise the potentialities of the situation, and they are eager to develop, but capital is needed, British for preference; population is needed, again British for preference (hard-working industrial people who seek to make a new start among conditions different from those that now obtain here); and manufacturers are wanted—British manufacturers who will put down works there. These are the three essentials for which Sir Joseph and the present exhibition make their joint appeal. If the Commonwealth cannot secure them from the Mother Country they will be forthcoming from somewhere else—the duty and responsibility of securing that there shall be a policy of continuous development is fully recognised by Australians who take the long view,

and, much as they desire to do so, they cannot limit themselves to British support if such is not forthcoming. Therefore, in order to perpetuate the British spirit and ownership, it is to be hoped that British statesmen, British financiers, and British industrialists will lend their aid to the furtherance of the policy of Colonial development in which British characteristics shall be preserved. The utilisation and development of our Empire resources and opportunities are not given nearly as much prominence as they deserve in our discussion of solutions of pressing problems of to-day.

The Exports Credits Scheme.

This scheme, which was one of the most hopeful stimulants that the Government has attempted to administer to overseas trade, has been in the limelight during the past week or two. Sir Philip Lloyd-Greame, who is at present the Government spokesman for the Department of Overseas Trade, has been explaining the features of the extended scheme. One of the most important is that the Government credit now takes the form of a guarantee that the bill created by an export transaction will be paid. It applies to every country, except India, Ceylon, the Straits Settlements, and Russia. The Department is prepared to guarantee up to 85 per cent. in cases where the credit exceeds twelve months, and, as regards length of time, is enabled to give a credit of from five to six years. This feature is of distinct value in larger engineering contracts. It is satisfactory to learn that the former hesitation on the part of British exporters in utilising the Exports Credit Scheme is disappearing. More are making themselves acquainted with its scope, and showing their appreciation of its methods of operation. They are realising, too, that it is run by a banker and not solely by Government officials, and therefore are showing more confidence in it. It would surely be worth while for electrical firms to examine the possibilities of utilising the scheme in the same way as the Brush Company has done. Mr. Broadhurst has expressed great satisfaction at the help he has derived from the Exports Credits Department in obtaining the contract for the electrification of a cement works in South Africa. It is understood that work in South America is under negotiation in similar fashion. Many a scheme involving the placing of large orders for material is probably filed away because the necessary capital has not been readily forthcoming. But for the lack of funds it might be possible to start on its way many a hydro-electric scheme, tramway conversion, electric lighting installation, or works electrification. Surely some of these could be brought an important stage nearer realisation with the aid of the Exports Credits Scheme. The local organisers of the Birmingham branch of the British Industries Fair has been drawing the attention of their exhibitors to the advantages of the scheme. Consideration of the matter should not be long delayed, for already the facilities are threatened with curtailment on the plea of economy. The Geddes Committee is said to have suggested that the amount available for next year shall be reduced.

Petty Tyranny.

A difference has arisen between the Wimbledon Corporation and the borough electrical engineer (Mr. H. Tomlinson Lee), which seems likely to have disagreeable consequences. Apparently trouble has been brewing for a considerable period; we may perhaps date its inception from the occasion, in May, 1920, when the Council declined to conform to the schedule of the National Joint Board, and narrowly escaped a shutdown at the hands of the Electrical Power Engineers' Association. On the intervention of the Ministry of Labour, the catastrophe was averted by affording the Council time to rescind its decision, under pressure from the Mayor, the Electricity Committee, and the chairman of the Committee. We believe that on that occasion Mr. Tomlinson Lee, who is a member of the E.P.E.A., preserved an attitude of neutrality, and it may be that the Council would have preferred his active support in combating the claims of the Association.

Later on, having a number of extensions in contemplation, the Council appointed a consulting engineer (Mr. C. P. Sparks) to advise not only with regard to the extensions that were required, but also on the system of supply, on the possibility of effecting economies, and on the desirability of linking-up with some other works instead of extending the plant. Mr. Sparks has submitted his report, and Mr. Tomlinson Lee has furnished comments thereon, but these documents, we believe, have not been made public.

The Electricity Committee has now recommended the Council to terminate the engagement of the electrical engineer on May 31st next, and to dispense with his services as from January 31st.

It is unnecessary to say that if this procedure is followed an irreparable injury will be done to Mr. Tomlinson-Lee, whose future career will be gravely prejudiced. The question was to come before the Council on Tuesday evening last, and in the meantime strong action has been taken by the Electrical Power Engineers' Association, the Chief Technical Assistants' Association, and the Associated Municipal Electrical Engineers on behalf of Mr. Lee, who has been with the Wimbledon Council for over 20 years. The E.P.E.A. in particular, not content with commenting on the prospective injury to Mr. Lee, has stated its intention "to take whatever action is necessary to prevent such an injustice being committed."

That the Corporation has a right to dispense with the services of its electrical engineer, of course, is not denied, and circumstances are conceivable in which the proposed procedure would be justified; but no such circumstances have come to our knowledge in this case—the length of Mr. Lee's tenure of office in itself affords evidence of friendly relations between him and his Council and of satisfactory service in the past. So far as we can ascertain, the trouble is really of a semi-political nature; it seems to have nothing whatever to do with Mr. Tomlinson Lee's professional skill or personal reputation, against which, we believe, there is no imputation whatever. If we are correct in forming these conclusions, it follows that the proposed dismissal, involving the most serious consequences to the engineer, would be an act of gross injustice, against which we must protest most emphatically; and if it be carried out the Wimbledon Corporation, which has only existed as such for comparatively few years, will brand itself as unworthy to be served by any decent engineer.

[As we go to press we learn that the Council on Tuesday adopted the recommendation of the Committee, and the E.P.E.A. has invoked the intervention of the Minister of Labour, with a view to securing the appointment of a Court of Inquiry.]

Compensation for Loss of Employment.

The recent adjudication in respect of the technical staff of the Morley electricity undertaking, on which we commented in our issue of January 20th, is of great importance to electricity works' engineers. Apart altogether from the Referee's decisions in this particular case, the fact that the question came within the scope of the Electricity (Supply) Act of 1919 at all is most satisfactory. It had been held in some quarters that such questions could be entertained, under Section 16 of the Act, only if they arose in connection with the new schemes promoted by the Electricity Commissioners. We see no justification for this view, for the Section clearly states that where a "scheme for the improvement of the supply of electricity in any district has come into operation, or an agreement or arrangement between various authorised undertakers for the rendering of mutual assistance to one another has been entered into," the provisions of the clause shall apply. The Morley case, however, settles the question, proving that arrangements made between *existing* undertakings for bulk supply or other assistance come under the Section.

AN ELECTRICALLY-DRIVEN CEMENT WORKS.

The works of the Kent Portland Cement Co., Ltd., at Stone, Kent, represents the most modern development in the art of cement-making, and is claimed to be one of the largest of its kind in this country. The whole of the works and power plant was laid out, and all the cement-making machinery delivered by Messrs. F. L. Smidth and Co., Ltd., who have acted as consulting engineers to the company, and by the courtesy of the management and Messrs. Smidth & Co., we were recently privileged to pay a visit of inspection to the factory and secured permission to describe the electrical plant which exclusively provides the motive power for the machines carrying out the various processes of manufacture.

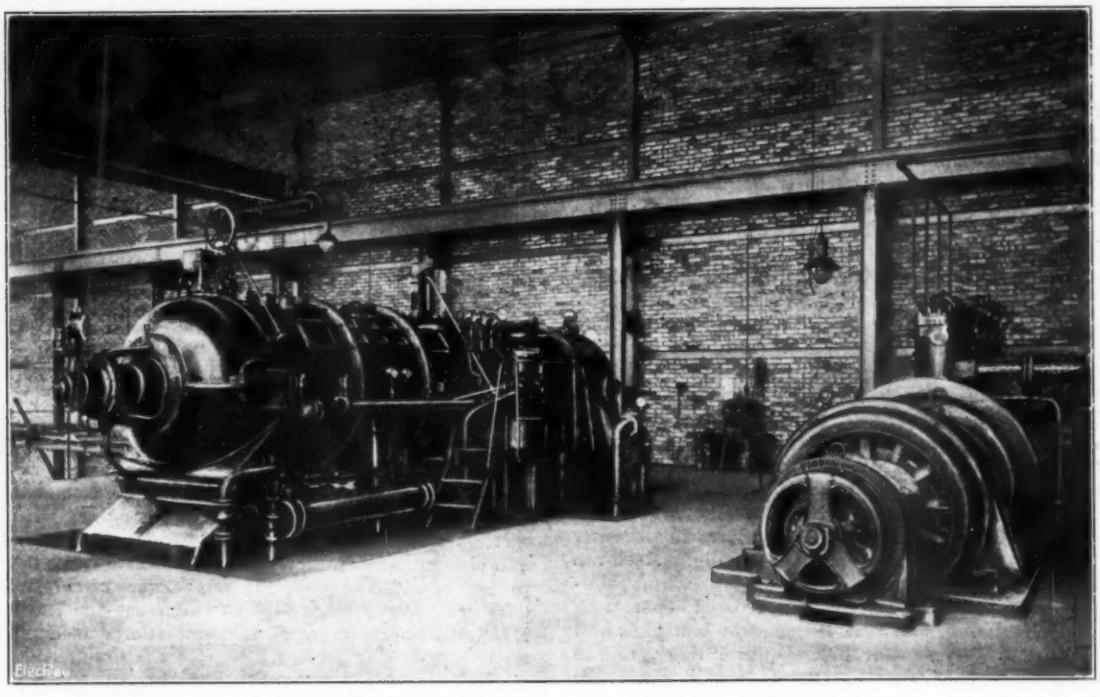


Fig. 1.—The Power Station—3,000-kW Brush-Ljungstrom Turbo-Generator.

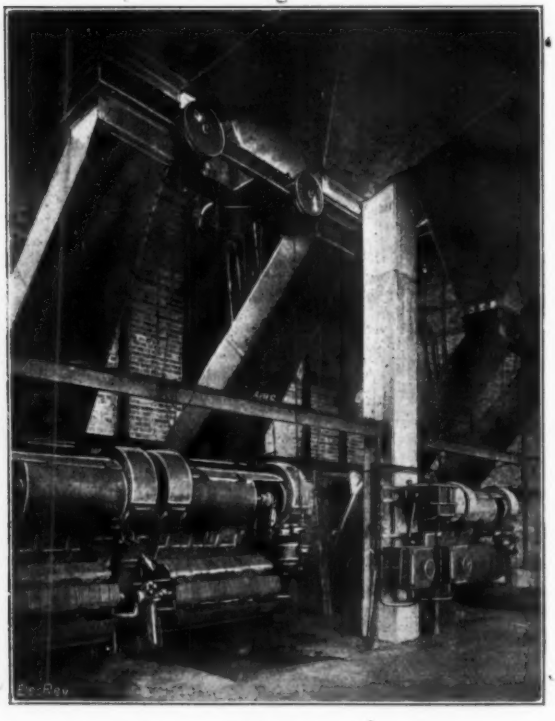


Fig. 2.—The Boiler House.

The power station (fig. 1) is a spacious, well-lighted, and well-ventilated building measuring about 90 ft. in length, 50 ft. in width, and 40 ft. in height, with a deep clerestory roof. Spanning the station is a 15-ton Herbert Morris hand-power travelling crane. The generating plant at present consists of a 3,000-kW Brush-Ljungstrom turbine, but space is provided for an ultimate installation of three such machines. The turbo-generator set is mounted above its condenser, as usual, and surrounded by a substantial floor at about

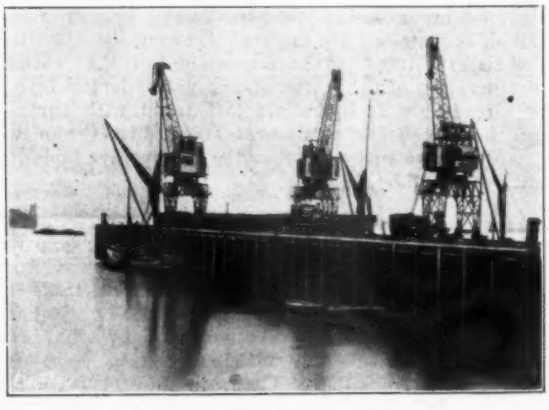


Fig. 3.—Babcock & Wilcox 4-ton Cranes.

half the height of the building. Three-phase current at 520-525 V, 50 cycles, is generated, and the alternators are cooled by separately-driven centrifugal fans, the air passing through a drying filter. Voltage is regulated by a Brown-Boveri regulator. Distribution is effected by means of a cubicle-type switchboard erected by Messrs. Johnson & Phillips, Ltd., fitted with oil-break switches and circuit breakers with no-volt and overload releases and time-lag devices. There are seven panels allotted respectively to the power plant, coal mill, kiln house, raw mill, cement mill, cooperage,

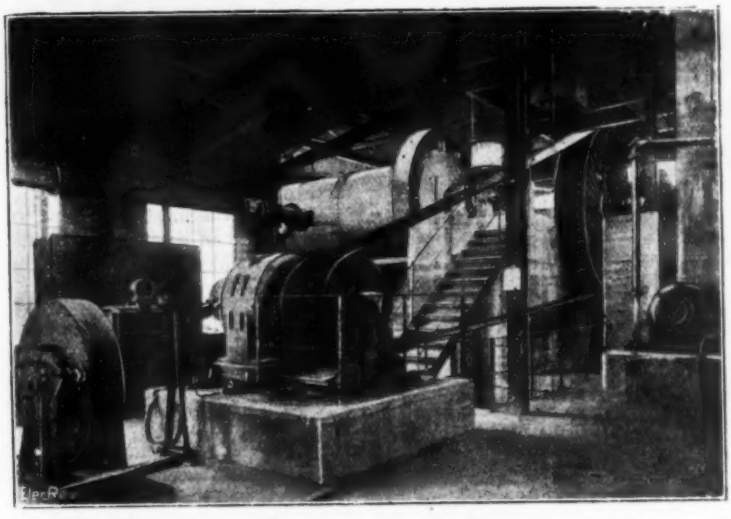


Fig. 4.—250-h.p. Sandycroft Motor Driving Tube-mill.

and cranes. An auxiliary set used for supplying lighting energy and power to small motors consists of a 4-cylinder Vickers-Petters semi-Diesel engine direct coupled to a Brush separately-excited generator with an output of 160 kW, three-phase, 50 cycles, 525 V. The boiler house, which is shown in fig. 2, like the power station, is constructed to provide accommodation for three times the present plant. The latter consists of two boilers made by Messrs. John Thompson Water Tube Boilers, Ltd. These each have a working pressure of 215 lb. per sq. in., a steaming capacity of 19,800 lb. per hour, with a heating surface 5,400 sq. ft. in area, and a grate area of 130 sq. ft. Steam is superheated to 662 deg. F. The back sections of the boilers form the economisers and have a heating surface of 1,900 sq. ft. The boilers are supplied with water by a Bailey & Co. steam pump and a Worthington-Simpson 7-stage rotary feed pump. Water for the condenser is taken from the Thames by a Worthington-Simpson vertical-type, low-lift centrifugal pump, housed on the jetty. The boilers are fitted with chain-grate stokers and forced draught fans manufactured by the Underfeed Stoker Co., Ltd., the gear on each boiler being driven by a separate motor. The air-pump installation comprises a Mirrlees-Watson multijector with heater. The condensate water is measured by a Holden & Brooke meter, consisting of a pivoted arm, which, when the water reaches a certain level, is tilted over by a ball-float and releases the collected water. The coal required for the furnaces and coal mill is brought in barges to the jetty, where it is conveyed by crane grabs into trucks which run over a permanent way which forms a network over the whole site. The trucks deposit the coal on a dump. From here it is taken as required and placed in the hoppers of a combined conveyor and elevator designed by Messrs. F. L. Smidth & Co., the engineers, which feeds into the hoppers shown in the illustration. Ashes are taken from the boilers by means of an Underfeed "Usco" water-sealed elevator and conveyor.

Turning to the manufacturing side of the works, the electric travelling jib cranes fitted with patent lever-luffing gear (fig. 3) are the first part of the electrical plant to receive notice. These run on tracks on the expansive jetty and were constructed by Messrs. Babcock & Wilcox, Ltd. There are three cranes, each with a lifting capacity of four tons. The arrangement of the driving gear inside the crane-house is a marvel of compactness. The hoisting drum is driven through double-reduction gearing by a 50-h.p., slip-ring motor, and there are motors for slewing and luffing, and also for moving the whole structure along the track. Mains are run underneath the jetty into three plug boxes, and from these tough-rubber-sheathed cables are taken to the cranes. The crane motors were made by the Metropolitan-Vickers Electrical Co., Ltd. The same firm also made the transformers which are installed in the cranes for lighting purposes. The main contactor gear was manufactured by Messrs. Allen, West and Co., Ltd., as were also the drum controllers operating the hoisting and slewing gear. The principal function of these cranes is the unloading of clay and coal from barges. The wash-mills are heavy vertical-spindle machines driven through gearing by 75-h.p. motors. The slurry tubemills are revolved by means of 250-h.p. Sandycroft motors, one of which is seen in fig. 4, by belt drives.

The slurry basins for the storage of the finished raw slurry from which the cement is produced are shown in fig. 5. The hut seen in the illustration contains a 20-h.p. motor driving paddles for keeping the slurry in constant motion. Power is supplied to the motor by means of slip-rings mounted at the centre underneath the hut. The controlling gear is situated in the washmill building.

The combination ball-tube mill motors are the largest in the works, and represent a great part of the load. There are four of them, made by Messrs. Sandycroft, Ltd. These are of the "Cascade" type, specially designed for grinding mills; they run at 160 r.p.m. The mills are directly connected to the motors by flexible couplings. The machines are started up by Sandycroft starters and controlled by oil-immersed switchgear of

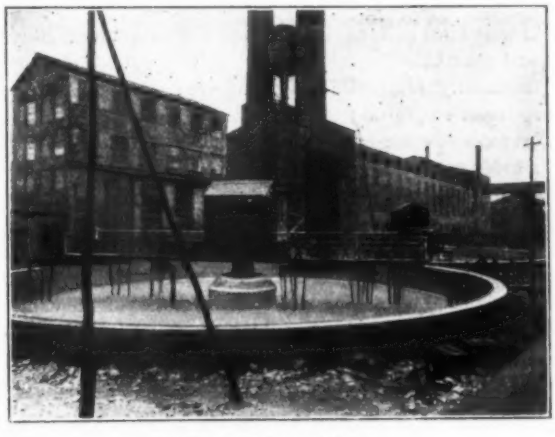


Fig. 5.—Slurry Basins.

Mr. Geo. Ellison's construction. The room containing three of these motors and their control gear is illustrated in fig. 6.

The finished cement is taken by a rubber belt conveyor running through a covered way from the mills to ten storage silos; the belt is kept in constant motion by 20-h.p. motors.

The whole of the works is well lighted. Outside

lighting, including that of the jetty, is effected by means of gasfilled lamps with porcelain reflectors fixed to brackets mounted on 20-ft. poles. The interior lighting is by means of vacuum lamps, the wiring being run in conduit where possible.

Altogether there are more than eighty electric motors, ranging from 1 to 300 h.p., and although many makers are represented the majority of the machines were constructed by Messrs. Sandycroft, Ltd., and control is almost exclusively effected by Ellison switchgear.

The factory is capable of a normal output of about three thousand tons of cement per week, the working being continuous night and day. A remarkable feature of the factory is the extent to which machinery has replaced manual labour, and, it being electrical machinery, a minimum of attention is required. To a visitor the works has the appearance of a place suddenly deserted by practically all of its "hands," the machinery being left running.

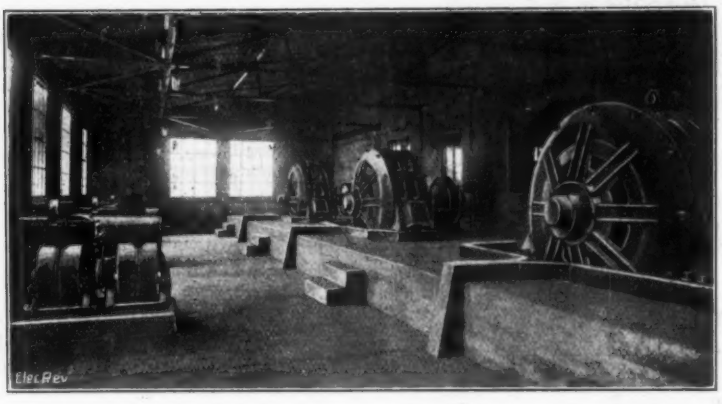


Fig. 6.—Three 300-h.p. Sandycroft Motors Driving Grinders.

LOCALISING A FAULT OF LOW OR HIGH RESISTANCE IN A SUBMARINE CABLE WHEN THE CONDUCTOR IS NOT BROKEN.

By J. IRYMER-JONES.

For this kind of fault localisation the writer has always found that Clark's well-known "fall of potential test" is especially serviceable, as compared with other tests sometimes employed; its reliability being due to the observations being made *concurrently at both ends of the cable during the whole time of testing for the fault's position*, and to the fact that the electrician can depend on the services of an assistant at the distant end who, it may be, is not at all an expert in this particular test, and who indeed has no greater knowledge than being able to charge a condenser c from his end v' of the cable, when instructed to do so, and then recording the discharge through his galvanometer g by means of key d.

An adjustable coil R has a resistance unplugged which the electrician considers appropriate to the cable's conductor resistance between his testing end and the fault to be localised, viz., such as will give suitably large discharge readings for the potentials V, v and v' in the test formula.

As the accuracy of the localisation result will very largely depend on the exact method of carrying out the test, the following details are important.

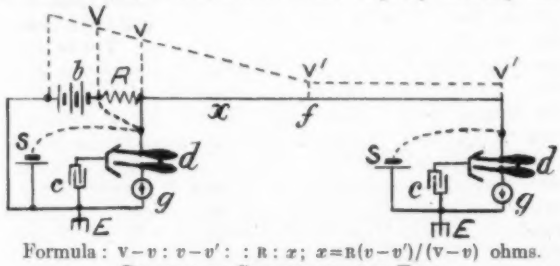
After the electrician has put the testing current to the cable through the resistance R, both he and his assistant at the distant end start recording a *series* of condenser discharge readings as quickly as the return of their respective "spots" to the zero position on the scale permits of. A large number of discharges—20 or so—can be observed during, say, 10 minutes when a dead-beat galvanometer is employed.

When the assistant finds that the testing current has been taken off, he can, if it has been previously so arranged, connect up to the speaking instrument and send to the electrician every one of his readings v' in the order in which they were observed. The electrician is thus put in possession of the whole *series* of the v' discharges, so that he can see any risings or fallings and compare them with the V and v discharge readings which he has himself recorded at his own end, and from them *select* what he considers to be corresponding changes for v and v' at the two ends. These values when corrected—as explained later on—enable the electrician to work out from the formula the position of the fault. It is, in fact, on the electrician's judgment in choosing the most consistent and reliable, and in discarding the more erratic, sets of readings for V, v and v' respectively, that the correct localisation of a variable fault will very greatly depend.

It is important for the assistant to start noting his condenser discharges v' a little *before* the prearranged time for the electrician to put the testing current to the cable, as he can thus ascertain the value of a few condenser discharges due to the charge given from the cable fault itself or *earth current*, and can signal these also when subsequently sending the *series* of condenser discharges v'. A marked change in the discharge value will show when the electrician has put the testing battery to the cable. Both the electrician and the assistant should continue to record a few extra discharges from the condenser *immediately after* the testing current has been taken off, because the f.o.p. test readings V, v and v', observed at both ends, will, later on, have to be corrected by the electrician for the *earth* or *cable current* (if any) affecting them, before applying them to the formula; consequently a note must also be made of the cable-current *polarity*, as indicated by the direction of the throws on the galvanometer scale.

If the condenser discharge, indicating the *cable current*, be in the *same* direction on the scale, it should be *subtracted*; but when in the *opposite* direction it should be *added*.

As the cable current, when due to the polarisation of a small fault, will decrease rather rapidly directly the testing battery is taken off, it should be observed, as soon as practicable, after reading the last condenser discharge of both the v and of the v' *series*.



Formula: $V-v : v-v' : : R : x$; $x=R(v-v')/(V-v)$ ohms.

Diagram of Connections for Test.

It will be found that although the fault resistance may vary considerably, the value of the V discharge, at the battery end of the resistance R, will remain comparatively constant, so that only an occasional V discharge need be observed; but as v and v' may both vary—owing to the fault-resistance, and also to the *earth* and *fault-current*, changing—as many v and v' discharges should be recorded as is possible in the time allowed for observations.

The assistant will have no difficulty in distinguishing the *test-discharge* from the *earth current* discharge, owing to their relative deflections.

Ten minutes will generally be sufficient time for making the f.o.p. test when everything has been prearranged at both ends. For charging the condenser four or five seconds will be ample.

Another great advantage of the f.o.p. test is that the resistance R can be quickly altered, for another *series* of potential discharges at both ends, to any other desired value in order to make the discharges *v* either greater or smaller, as desired, compared with V.

Another possible variation is to use, say, the same resistance with a larger or smaller testing battery. Under these altered conditions an additional series of condenser discharges may be observed at both stations to get another fault localisation as a check on the previous test result.

Tests with different battery powers and resistances R are very important because, if the conductor exposure be small, a low battery power of 10 volts or so will polarise the fault less than a larger battery power; and often the discharge readings *v* and *v'* will be much more steady and comparable in consequence.

As V, *v*, and *v'* must all be expressed in the formula in terms of the *same relative values*, it is imperative that, at the end of each *series* of his discharge readings, the assistant send two or three discharges from his condenser, after it has been charged for, say, four or five seconds, with a *standard-cell s* agreed upon of *known* electromotive force.

It is very important indeed that the standard-cell *s* be used only for charging a *condenser*, and not on any account to obtain a *continuous* current which would speedily reduce its e.m.f.

When very reliable standard-cells are not obtainable at a distant station, small rectangular "Obach" *dry* cells are very suitable because easily obtainable, cheap, very small and compact, so that three of these can be posted to the assistant; their e.m.f.'s should be compared immediately before using them for the f.o.p. test, and the most reliable one of the three employed as the *standard* cell. If this be adopted then, before sending the three Obach dry cells to his assistant, the electrician should keep a record of their discharges as compared with his own standard cells. *Three* cells are recommended, because if only used for condenser discharge tests their agreement will be a tolerably reliable proof of their e.m.f. having, in each case, remained *constant*.

It is well for the assistant to send his readings *v'* at the end of each *series* in case the fault might open out during any test and make communication difficult; but if, during the first series, there is no evidence of this, then several series—pre-arranged by the electrician before going from the station to the cable hut—can be made in succession without any speaking between the separate series.

For the f.o.p. test the electrician, in his cable hut, can vary the resistance R, or the battery power, or both, according as he finds that the test-readings for V and *v* and *v'*, of the last *series*, indicate as desirable. When the assistant gets condenser discharges of a greatly reduced value, showing that the electrician has taken off the testing current, he will understand that he can either connect up to speak to the electrician, and send his own recorded values of *v'*; or else, if it has been arranged that there is to be no speaking from the cable huts, prepare to observe another series of condenser discharges for another test.

This method of not speaking between successive series of condenser-discharge readings is sometimes convenient between two cable *huts*, as it saves time, and the trouble of carrying speaking apparatus from the station to the huts. In fact, it was adopted by the writer with very satisfactory results when localising a fault of high resistance in 1879, the transmission of the readings V and *v*, or *v'*, as the case might be, being reserved until the electrician and his assistant returned to their respective *stations*.

Another great advantage of the f.o.p. test is that if the order of procedure is reversed, and the assistant is told to put the testing current to the cable through a resistance of a stated value; then, if the result does not agree approximately with that previously obtained, it shows that there is probably more than one fault in the cable.

E.g., on one occasion a f.o.p. test showed that at least two faults were in the cable, *viz.*, one near to the north end and another at apparently no great distance from the south end.

As the northern end was very deeply buried in the sand on shore, and moreover as the water close in-shore was too deep to under-run the cable from the hut-end seawards, the ship raised the bight at a short distance from the shore, and a length of d.s. type was run out from the ship to the hut to make a loop-test. This placed the fault near to the hut where it was rocky and dry. A connection was next made on board, between the main cable running southward and the seaward end of the deep sea, already landed at the hut, to keep up temporary telegraphic communication, while another piece of cable was being spliced in to bridge over the fault in the beach cable.

When this was finished the original seaward section was again spliced on board to the main cable, thus completing the northern repair and putting the cable through southwards. Another f.o.p. test made from the cable-hut pointed to the existence of at least another fault near to the southern end.

On steaming south, and cutting the cable near to the water's edge, this fault was found in the u.g. cable, and, when removed, the section tested satisfactorily.

The above consideration emphasised the importance, when practicable, of first cutting a faulty cable at both ends *near to the water's edge* when tests show that there is reason to think that more than one fault may exist in the section.

The shore portion of a cable is specially liable to develop d.r. weakness either in shallow water, or among rocks, or where subjected to the sun's heat or drought, or the ravages of insects, or mechanical injury.

The danger of trusting to the localisation of the *resultant* fault was again exemplified in the same cable (about 900 n.m.) when, during another repairing expedition, five faults were found between five and thirty-seven n.m. from one end. Had these been more widely separated it would have proved a much more serious consideration, as the cable would probably have been grappled for, and cut somewhere nearer to the *resultant* fault's position than would have been the case if a f.o.p. test, taken from *both* ends, had given different results, and thereby indicated the existence of *at least two faults*.

Clark's f.o.p. test was published in the 1871 edition of "Clark & Sabine's Electrical Tables and Formulæ," and since 1875 has always been a favourite test with the writer for localising faults in a submarine cable on account of its *simplicity*, and because it is capable of giving very correct results—even when the fault's resistance changes under polarisation—if employed with great judgment. It has, therefore, always seemed remarkable that this test used not to be described in greater detail in the early text-books of our leading practical cable electricians who, it would appear, preferred the *Earth Overlap*, which, in the writer's opinion, has much less to recommend it than Clark's f.o.p. test, when judiciously applied.

It is true that when there is only *one* fault, of only a moderate resistance, the *Earth Overlap* is a good and serviceable test, and very convenient also, inasmuch as there is generally a Wheatstone bridge available at all cable stations, as well as someone capable of using it for an *Earth Overlap;* but an f.o.p. test is preferable to it, as the *series* of potentials V, *v* and *v'* are concurrently observed and show their relative changes *during the whole time* that the test is being made.

The f.o.p. test was successfully employed to localise a small fault having a very varying insulation resist-

ance—at times amounting to half a megohm—which had developed during the sheathing and laying process; and, on another occasion, to localise a fault caused by a small quantity of gritty substance in the *single* gutta-percha covering. This last-mentioned cable lay on an even and firm sandy sea-bottom.

In both the above cases the fault resistance was so high and varying that the localisation would have been impracticable, or at least very uncertain, if the Kennelly-Anderson *Earth Overlap* test had been relied on; and, even when practicable, it is not so quickly made.

Both the sheathing and the jute-serving over the faulty core were in as firm and compact a condition as when the cable was first laid.

THE SELLING OF ELECTRICAL APPLIANCES.

The third of the E.D.A. series of Salesmanship Conferences was held at the rooms of the Chartered Institute of Patent Agents on January 20th, when Mr. W. A. Gillott, of the Jackson Electric Stove Co., opened a discussion on "Salesmanship in relation to Electric Heating and Cooking." The chair was occupied by Capt. J. M. Donaldson, who, in his opening remarks, dealt with what he called the fetish of the obsolete. In almost every house using electric light, he said, one would see an electrolier, which was a copy of the old gasolier. The gas people had a good reason for using a gasolier, because if the lights were put high up they would blacken the ceiling. Electric light, however, was a different matter, and in most cases the electrolier could be done away with. The fetish of the obsolete was not confined to electric lighting, but extended to electric radiators. The electric radiator was as portable as a coal-scuttle, but in many cases a radiator was fitted, with a short length of cord, in a fireplace, just because originally the fire was there. That was a great mistake, because the great advantage of electric heating was that it could be localised. It should be pointed out that a radiator could be taken from one room to another. Then, with regard to cooking, the ordinary kitchener was low, and it was necessary to stoop to put anything into it; electric ovens should be made so that they could be mounted in a convenient place, and at a convenient height.

Mr. Gillott, dealing briefly with the chairman's remarks, said it was yet his pleasure to introduce to him an oven which he could work on a table. He used the oven in his own home. Passing on to his paper, Mr. Gillott confined himself to the leading questions which arose in the ordinary course of soliciting business. Dealing first of all with the salesman, he said that in any class of business, successful salesmanship was built upon a definite and well thought out plan of campaign. While the fundamental principles were similar, different methods of application must be employed when dealing with different classes of prospects, such as domestic users, hotels and restaurants, or canteens, and in selling appliances to the Trade. This demonstrated the necessity of being versatile.

The salesman would probably be called upon to cite definite cases where similar installations to the one he was endeavouring to make were being satisfactorily operated. He would be expected to give facts and figures immediately, to substantiate his statements. His advice would be asked as to the best method of operating certain appliances, and why he considered it the best. His answers to these various questions must be positive and given without hesitation. In selling electric cooking and heating apparatus, he would be brought into touch with all classes of people, from the employés who used the apparatus, to the "man who paid the bill," and, especially in the case of domestic cooking, he would meet the housewife and the cook, and, in all probability, it would be found necessary to advise them regarding methods of cooking to secure the best results under the new conditions. It was advisable, when the business permitted, to employ a lady demonstrator for this work—but in any case the salesman should understand "kitchen language." Again, in order to bring forceful arguments in favour of electricity, he must know his competitor. Mr. Gillott did not merely mean that the salesman should understand the main principles of the goods, or commodity, the competitor sold, but, as far as possible, ascertain his method of attack. For instance, some time ago Mr. Gillott approached an architect regarding electric cooking for an institution, and was advised that gas had already been decided upon and the appliances ordered. He discovered that the gas equipment was totally inadequate for the job, but the meter and the supply pipes were large enough for a complete installation. He proved that the gas appliances were unable to perform the work required, and secured a hearing of his proposals, which resulted in the cancellation of the gas contract of £300, and the receipt of an order for electrical appliances for over £900. The competitor's object was to put forward a low price to get in, and rely upon the extensions for the complete job—a really bad policy to adopt on a cooking installation.

If it was necessary to refer to a competitor when selling, the salesman should not make the fatal mistake of running him down. He should carefully demonstrate that his own product also possessed the same advantages, with the addition of certain others, which made a considerable difference to its utility.

A salesman should not talk too much about price, but should try and keep costs in the background until he had interested his prospect; he should create a desire for possession of his goods, and their cost would be more of a secondary consideration. If, however, his efforts were unsuccessful, he should endeavour to ascertain why he lost, and use the experience for the next attempt.

The claims for electric cooking and heating should be supported by positive facts; it was useless to make a statement and leave it. For instance, the claim for cleanliness was agreed, because electric heat was not produced by combustion, there was no smoke to blacken the walls, &c., no fumes to vitiate the atmosphere, no dust or dirt, and no ashes to clear away. Satisfactory cooking results were repeated, because electricity was of constant heat value. There was 3,440 B.th.u. in one kWh of electricity; therefore if it took half-an-hour to perform a certain cooking operation to-day it would take the same time to-morrow, next month, or next year, under identical conditions. Electric cooking meant low labour costs—especially in large kitchens, because a turn of a switch was all that was required, as compared with the carting of coal and coke for a fire range or steam boiler, and the carrying away of ashes, and extra cleaning. Electric cookers were convenient and safe, because the risk of fire or explosion was reduced to a minimum, and no special provision was needed for ventilation. Electric cooking was economical, because a family of six persons could be catered for—including cooking—for 40 units per week, and in the case of canteens or restaurants, at a consumption of from 2 to 4 units per person per meal. An electric household of from eight to ten rooms could be run by one maid instead of two. The apparatus did not call for special foundations or setting, or extra flues, and, in the case of large kitchens, the floor space occupied was much less. Also there was economy due to less shrinkage of meat and the saving on the renewal of kitchen utensils, whilst maintenance costs were low.

There were one or two simple and useful details which should be memorised; they were: In cooking for middle-class families the consumption of electricity averaged one unit per person per day; electricity at 1d. per unit was equivalent in fuel cost to gas at 2s. 6d. per 1,000 cu. ft.; in large ovens an average of nine to ten lb. of meat could be cooked per B.O.T. unit consumed; for room and small office heating an allowance of one watt per cu. ft. was approximately correct; with self-contained water urns or kettles one unit would boil one gallon in half-an-hour under average conditions.

It should be a salesman's endeavour, as far as possible, to act in an advisory capacity to his client. It might be necessary to advise him to accept appliances of less value than he intended to purchase; in this way a salesman would gain prestige which would be of great value to him later on.

The salesman would often be asked: "What do you use at home?" He should be in a position to answer: "Electricity," and show the courage of his convictions.

Mr. Gillott then gave a few figures of his own installation, for 1921. His household consisted of six persons, and there were seven occupied rooms. The lighting, cooking, and heating connections approximated from 17 to 18 kW, and the total cost of electricity for all purposes was £27 19s. 6d. for the year. Had he not used electricity he would have been compelled to engage additional help costing at least £50 or £60 a year.

Mr. Gillott strongly recommended the younger men to thoroughly study the subject of heating and cooking. There was no doubt that electricity for domestic uses was going to figure very largely in future business.

In order to secure the best possible results, however, there were two essentials, namely, cheap electricity, from a sympathetic supply authority, and a smart showroom. These facilities were not available in every district, but it was only by hammering home the necessity for them, with the help of the E.D.A., that they would ultimately see them established throughout the country.

Discussion.

In the subsequent discussion Mr. A. F. Berry (British Electric Transformer Co.), first emphasised the importance of the salesman of electrical apparatus using in his own home the goods he was trying to sell; he then passed on to the economies which were effected by the use of electrical apparatus. It was a good thing that the public, generally, believed more in the advantages of electric heating and cooking than electrical engineers did; if the public were not "off the mark" quicker than many of those in the industry, there would be no industry to deal with. Mr. Berry stated that he had taken the average consumption of electricity for cooking at "Tricity House," extending over some tens of thousands of meals, and it had worked out to

approximately four meals to one unit of electricity. He related also the experience of a gentleman to whom he had recommended electric cooking, and who asked over a hundred people what their opinion of it was. 75 per cent. of them had told him that it was very expensive, whilst the remaining 25 per cent. had said that they would not part with their cookers. It was found that not one of the 75 per cent. had ever tried electric cooking.

Mr. Steele (Dowsing Radiant Heat Co.) said that while it might be a very good thing to sell small heaters for local heating, they were not the only things to be pushed. There was a lot of small, cheap heaters, with low energy consumption, sold, and he considered that business had been retarded through heaters of very small capacity being sold for warming very large rooms.

Mr. Napier Prentice spoke of the need for indicators on electric ovens. In a certain bakehouse it was noticed that cakes baked in an electric oven were bigger than those baked in a brick oven, and experiments were made which showed that they also weighed more.

Mr. Evis dealt with the cost of selling apparatus. Selling was split up into two parts, the selling of the goods and the selling of the idea. If a salesman would confine himself to the selling of the goods, explaining their particular points, rather than go into the educational side, he thought it would be much better, because there were drawbacks to the educational side being handled by those not fully capable. It would be better if the educational side were dealt with by the E.D.A.

Mr. Nobbs pointed to the advantages of electric water heating, which was now coming into its own. Somehow or other, electrical people must condemn something, and it seemed that at present they were condemning water heating. He suggested that heaters should not be sold for heating rooms, but for heating objects in a room.

Mr. Beavis asked Mr. Gillott to amplify his remarks with regard to persuading a householder, who was often faced with the obstinacy and ignorance of the cook, to adopt electric cooking.

Mr. Morton emphasised the importance of hiring schemes. It seemed to him that, seeing that a householder could hire a medium-sized gas cooker for about 2s. per quarter, the electrical salesman was at a very great disadvantage in trying to sell apparatus costing £20 or £30.

Mr. A. Gowans Whyte said that the only part of the world where there seemed to be hiring of electric cookers was across the border. Cookers could be hired in Glasgow for 10s. a quarter, and gas cookers, he understood, were put into a house for nothing.

Mr. Howell (Falkirk) referred to selling apparatus by exhibiting it in a showroom. If a salesman was trying to point out that electricity was clean, the least he could do was to keep his own showroom clean. He had seen a showroom where electric vacuum cleaners were exhibited, and yet the carpets were thick with dust. If they were going to sell electrical apparatus, they must get the co-operation and help of the supply authorities.

A Speaker referred to Mr. Gillott's remark, that with electric cooking one could always do the same thing on one day as on another, and that conditions were constant, and said that it was possible to get totally different results, owing to a drop in voltage. He himself had been using electric cooking for years, and his average consumption, for three adults, was nine or ten units per week.

Mr. Hall, dealing with the ease with which electric cookers could be used, said that in his own house he had a girl of 15 years of age, who, after a fortnight's instruction, was left to cook and serve a meal quite alone, and she had done the work with entire success.

Mr. W. E. Warrilow said more use should be made of the fact that when meat was cooked in an electric oven, there was less shrinkage and waste. The initial cost of an electric cooker could be recovered in a short time by the saving in meat. He believed that hiring was the real solution of the problem of selling electrical appliances. He suggested that the conferences should be presided over by chairmen who were men engaged in the sale of electrical apparatus.

Mr. Young suggested that cable makers, contractors, manufacturers of switchgear, manufacturers of apparatus, and supply companies in London should co-operate and, through the E.D.A., educate architects up to the usefulness of electricity for cooking and heating, so that they would then persuade their clients to install cables in new buildings, ready for the apparatus to be put in.

Mr. Gillott, replying to the discussion, impressed upon his audience that electricity for cooking and heating was about a quarter the price of electricity for lighting, and it was surprising how few knew that. If the industry, as a whole, would put up more money, he knew that the E.D.A. would only be too willing to spend it in engaging experts to interest people, for the benefit of the whole community. He agreed with Mr. Nobbs as to water heating, and gave an example of coal-saving by the use of electricity. Mr. Gillott also gave an example of a village of "all-electric" houses, where it was found that the average maximum demand per house was 0.8 kW, to prove that the assumed capital charges in connection with buried cables need not be so high as was often the case. With regard to voltage fluctuations, these made very little difference when cooking.

At the conclusion of the discussion, votes of thanks were accorded Mr. Gillott, for his paper, and Capt. Donaldson, for presiding.

IMPERIAL WIRELESS TELEGRAPHY.

Wireless Telegraphy Commission's Report.

In December, 1920, the Cabinet appointed a Wireless Telegraphy Commission, consisting of the Rt. Hon. Viscount Milner, G.C.B., G.C.M.G. (chairman), Messrs. W. H. Eccles, D.Sc., F.R.S., M.I.E.E. (vice-chairman), L. B. Turner, M.A., M.I.E.E., E. H. Shaughnessy, O.B.E., M.I.E.E., and Lieut.-Col. C. G. Crawley, R.M.A., M.I.E.E. (secretary), to (i) decide upon the wireless plant most suitable for carrying out the scheme of Imperial wireless communication recommended by the Imperial Wireless Telegraph Committee, bearing in mind the necessity for the co-ordination of the chain with existing telegraph services, and to design the necessary stations; (ii.) make recommendations regarding the actual sites for the stations proposed by the Imperial Wireless Telegraph Committee; (iii.) advise generally upon the preparation of specifications for machinery and apparatus, the making of contracts and the construction of the stations.

The Commission has presented its report*, which is signed by all the members except the chairman, and in view of its expressly technical nature the vice-chairman contributes an explanatory summary in the form of a foreword to the report.

The first section of the report recapitulates the recommendations of the Imperial Wireless Telegraphy Committee (1919-20), which the Commission was instructed to follow.† The next sixteen paragraphs deal in a broad way with the problems regarding masts, antennæ, machinery and apparatus presented by the installation of thermionic valve plant on a scale larger than hitherto attempted, and describe the solutions arrived at. Special attention is paid to the thermionic valve plant itself, to the ability of the industry to meet the probable demands, and to capital and maintenance costs.

The visit of the Commission to the Marconi Co.'s station at Carnarvon is referred to. The conclusions drawn are: first, that the installation at that station is approaching the order of magnitude required in the chain stations; and, secondly, that the Marconi Co. is in a position to supply full-size thermionic equipment for the chain stations. The Carnarvon station has succeeded in communicating with Australia direct at certain hours of the day, and, therefore, it is certain that the chain station in England, which would be of three or four times the signalling strength of the Marconi station, could communicate with Australia throughout a longer diurnal period.

In later paragraphs improved methods of reception and the general arrangements of the receiving stations are described. Under the heading "Sites" is given an outline of the work which was undertaken by the Commission at the request of representatives of the Government of the Union of South Africa, showing the advisability of erecting a new African terminal station near Johannesburg in preference to adapting the ex-German station at Windhuk.

The second section of the report is headed "General Recommendations." Paraphrased briefly, these are to the effect that:—

(1) Thermionic-valve stations should be erected in England, Canada, Australia, South Africa, and India. A thermionic-valve station should also be erected in Egypt to duplicate the arc station now being completed by the British Post Office at Abu Zabal. At each of the other centres, namely, East Africa, Singapore, and Hong Kong, an arc station should be erected with space for the addition of thermionic-valve plant later.

(2) Two wavelengths should be allocated to each transmitting station.

(3) Each country should have one receiving centre (excepting Canada) and that centre should be equipped for reception from several of the chain stations simultaneously.

The third section of the report consists of detailed technical recommendations. For each country (excepting Canada), specifications are given of the masts, machinery and buildings appropriate to the locality. These detailed technical recommendations are briefly reviewed below:—

* Cmd. 1,572. H.M. Stationery Office, Kingsway, W.C. Price 1s. net.

† Elec. Rev., July 9th, 1920; p. 42.

England: The four steel transmitting station masts, each 250 metres high, should be erected one at each corner of a square, with provision for the addition of two masts at each end later. The tuning coil should be designed for an antenna current of 500 amperes, and provided with tappings for tuning the wave lengths between 3,000 and 16,000 metres. The thermionic valve set (in duplicate) should deliver at least 120 kW, and be capable of sub-division in stages, so that a fraction of the total power may be delivered to the antenna at will; it should be capable of extension to 240 kW. Energy may be supplied from d.c. machines (10,000-12,000 volts) or by rectifying a.c. Transmission must be continuous at hand-speed, and at 90 words per minute at full power for reception at 2,500 miles. The Marconi Co. should be invited to tender for the supply of thermionic valve plant and associated equipment. For the supply of electrical power a steam generating station containing oil or coal-fired water-tube boilers and 250-kW, 3-phase, 50-cycle, 3,000-volt (or 200-kW 10,000/12,000 volt d.c.) turbo generators should be built. The emergency gear should comprise a small aerial, a Post Office receiving set, perforators, automatic transmitters, and recorders.

The receiving station should be at Banbury, and provided with two sets of apparatus similar to that being installed at Banbury for the Leafield-Abu Zabal link of the chain, but supplemented by limiting apparatus. An additional aerial system and receiving gear will be needed when Canada enters the scheme.

Canada: A technical conference of Canadian Government representatives should be convened to discuss with the Commission special problems arising out of her geographical position. The transmitting and receiving stations might be as described above.

Australia: Alternative designs are suggested, one of which could probably be carried into effect almost entirely by industries already established within the Commonwealth. The transmitting station should be as outlined above, unless an ample public supply of electricity is available; in the latter event the transmitting station may be similar to that recommended below for South Africa. The receiving station should have two aerial systems and three sets of receiving gear, with accommodation for a third outfit for direct communication with South Africa when desired. When a station is built at Vancouver (Canada) additional receiving equipment will be needed, and apart from this, additional receiving gear will be necessary if the chain station is to work across the continent of Australia. The Australian Government prefers the chain station to be at Perth rather than Port Darwin.

South Africa: If the transmitting station is placed near Johannesburg the masts, antenna, &c., thermionic set and emergency gear should be as recommended for the English station above. For the supply of electricity 250-kW, 15,000-volt, 3-phase transformers, &c., and overhead transmission lines in duplicate will be needed; an alternative would be the use of 200-kW, 10,000/12,000-volt d.c. motor-generators. Mercury-vapour rectifiers may be substituted for the rotary converters.

The receiving station should have one aerial system and two sets of receiving apparatus in the first instance, with accommodation for a second outfit for direct communication with Australia when desired.

India: A station similar to that planned for England is suggested.

Egypt: The transmitting station, unless placed at Abu Zabal, should be as described above for the English one. A single receiving centre for both the new valve station and the arc station is proposed, and from that centre both stations would be controlled. Special receiving apparatus is proposed; the receiving station should have four aerial systems and five sets of receiving apparatus.

East Africa: The masts, antenna, &c., and emergency gear should be as outlined above for the English station. Two 250-kW arc sets and accessories should be provided similar to those at Leafield (Oxfordshire). The hydroelectric project at Thika (reported upon by the Public Works Department, Nairobi, on March 30th, 1914), should be carried into effect at least in part if, as seems possible, the wireless transmitting site can be near the falls, with reservation of the water power of the Chania for future extensions. Water-turbine 250-kW, 500/1,000-volt d.c. sets would be used, with duplicate overhead transmission lines. Should the hydroelectric project be impracticable, electricity should be generated by steam, as recommended below for Singapore. The receiving station should have three aerial systems and four receiving sets, with accommodation for a fourth outfit for direct communication with England if desirable.

Singapore: The masts, antenna, &c., and emergency gear should be as those described for the English station, and the arc equipment should be similar to that to be used in East Africa. Electricity should be derived from a steam generating station housing 250-kW, d.c., 500/1,000-volt reciprocating engine sets. The receiving station should contain three aerial systems and four sets of receiving apparatus.

Hong Kong: Four 200-metre masts should be erected, one at each corner of a square, with provision for two additional masts at each end later. The antenna, &c., and emergency gear, should be as recommended for the English station. The arc equipment should be as that recommended for use at Singapore and in East Africa, and the electricity should be supplied by a steam station similar to that suggested for use at Singapore. The receiving station should be generally the same as that used in Australia.

All the stations, except the English ones, will need a 12-kW d.c. supply (public or oil engine) for lighting, charging batteries, and operating the telegraph apparatus, and it will be necessary to interconnect the transmitting and receiving centres of each station by means of duplicate telegraph lines.

The structural work and machinery at each station have been planned with the endeavour of keeping the probable cost within the approximate estimates submitted by the Imperial Wireless Telegraphy Committee, *i.e.*, the average cost of the overseas stations will not exceed £160,000, exclusive of the cost of erecting residences for the staffs at some of the stations. The stations in England, Egypt, East Africa, Singapore, and Hong Kong, for which the Imperial Government is presumably responsible, should not exceed in the aggregate the sum of £853,000.

Looked at as a whole, the report provides specifications sufficiently full for the immediate preparation of estimates, and a later report will give detailed specifications. All the stations are planned to permit of easy extension of antenna, buildings, and plant.

Finally, it should be emphasised that during portions of each day much of the Imperial strategic, official, and news traffic could be carried on by direct communication between any pair of principal centres, the intermediate stations being omitted; but the intermediate stations would be necessary for relay work during the less clear portions of the day, and also for handling their own local traffic. The news messages transmitted from the principal centres could be received at many stations in the Empire, for example, in New Zealand, at the cost of an inexpensive addition to their existing receiving equipment. Foreign stations in many parts of the world would be able to pick up news and propaganda from one or other of the principal centres.

The report terminates with an appreciation of the help rendered to the Commission by the Admiralty, the War Office, the Air Ministry, the Post Office, and the Department of Scientific and Industrial Research, and with a similar tribute to individuals.

LEGAL.

Prosecution of Power Company's Employes.

At the Radcliffe (Manchester) Police Court, on January 25th, R. Kirkpatrick, F. Hall, I. G. Ivers, and William Speak, four engine-room attendants employed by the Lancashire Electric Power Co. at their station at Outwood, near Radcliffe, were summoned for maliciously breaking their contract of employment, whereby they jeopardised the maintenance of the undertaking.

Mr. C. H. Pickstone appeared for the company, and Mr. Kinsey (Wigan) for the defendants.

Mr. Pickstone, at the outset, said the proceedings were taken under an Act of Parliament made in 1875 for the maintenance of public services, such as gas and water, and which in 1920 was applied to electricity undertakings. There was no quarrel whatever between the company and any trade union; the case was personal to defendants themselves. The men were on night duty on the 9th inst., when they were engaged in running 10,000 kW of the 40,000-kW plant. The switchboard attendant was a young man named Gore, and it was the practice for him to be provided with tea, as he was not allowed to leave his post without the sanction of the charge engineer. At 11 o'clock he wanted tea made, and Ivers objected to Hall's making it. Further, he assaulted Gore. Words followed, and Ivers told the charge engineer that he was going home. He was joined by the other defendants, and all four gave an hour's notice of their intention to leave. Efforts to avoid this did not avail, and the station was abandoned to the care of two charge engineers. This was at 1.20 in the morning. Urgent messages were sent to the staff due to come on at the morning shift, and they responded. The position was explained to them and they went on duty. But for nearly two hours the undertaking was jeopardised and public services were in danger of being withheld. Happily no mishap occurred. The proceedings were instituted to show the illegality of the course pursued by defendants. The next morning the defendants claimed to have asserted a right in giving an hour's notice, but legally a week's notice on either side was necessary to terminate an engagement. He was bound to say that the rules of the trade union which the men had joined were the most constitutionally framed rules he had seen in a lengthy experience.

Mr. Kinsey said he admitted almost every word Mr. Pickstone had used and he endorsed much of what he had stated. The defendants thought that as Gore would have finished his shift at 12 o'clock he might have waited for his tea. A little pin-prick had caused the whole trouble. It was definitely in the minds of the defendants that an hour's notice could be given, and they felt that with two engineers in charge nothing serious would happen. But they were now very sorry for what had taken place, and on their

behalf he expressed regret. He hoped the justices would not send them to prison and suggested that the case would be met by the payment of costs.

The justices regarded the offence as very serious indeed, and could not do less than order each defendant to pay £5, the prosecuting advocate's fee of five guineas, and the expenses of witnesses.

Hightensite, Ltd., *v.* Rotax Motor Accessories.

The quality of ebonite separators was the issue in an action brought before Mr. Justice Sankey's Court in the King's Bench Division on January 26th and 27th by Messrs. Hightensite, Ltd., manufacturers of insulating materials, Gresham Street, London. The defendants, the Rotax Motor Accessories Co., Ltd., Chandos Road, Willesden, resisted a claim for £593 odd, the balance of goods sold and delivered, on the ground that the separators were not fit for the purpose required.

Mr. Lewis Thomas, K.C., for the plaintiffs, explained that in November, 1919, it was agreed between the parties that plaintiffs should supply defendants with a quantity of ebonite separators; deliveries were made at the rate of ten thousand a week as required. Certain deliveries were made and duly paid for, and it was understood that the articles were to be examined on delivery. The deliveries in question were not returned by the defendants in accordance with this arrangement, but subsequently, when the time for rejection had passed. After pressure defendants took back these deliveries which they returned, but afterwards refused to meet the account in respect of them, pleading that the separators had defects which rendered them useless.

Mr. W. H. J. Downton, general manager to the plaintiff company, gave evidence as to the manufacture of the goods. He tested a battery containing the Hightensite separators complained of and those of another manufacture. In no case did he find any material difference in the efficiency of the two types.

Cross-examined, witness denied that the company had received a number of complaints of late concerning the quality of their separators. The ebonite used for their separators contained about 4 per cent. of lime, 35 per cent. of sulphur, and 3 per cent. of litharge.

Mr. H. J. Creppell, formerly chief electrical engineer to Messrs. Vickers, gave evidence that he had tested the separators in question and found that they showed a little more efficiency than other types.

Dr. W. R. Ormandy, for the defence, gave the results of his analysis of the separators. When he tested them in a battery there was a remarkable loss of efficiency. In his opinion that was due to excess of lime, which caused disintegration of the spongy plate. As a result the batteries ran out very quickly.

His Lordship observed that it might be better to refer the matter for a report, since there was a technical difference at issue. There was then a consultation between the parties, and counsel afterwards intimated that a settlement had been reached upon terms endorsed on their briefs.

Swarren, Ltd.: A Shareholder's Application.

In the Chancery Division on January 27th, Mr. Justice P. O. Lawrence had before him a motion by the Hon. Bruce Ashley Ogilvy asking that his name be removed from the register of shareholders of Swarren, Ltd., of Theobald's Road, W.C., as the holder of 3,000 shares on which he had paid £300.

Mr. Jenkins, K.C., for the plaintiff, asked that the matter should go into the witness list, as he desired to call further evidence.

Mr. Ward Coldridge, K.C., opposed the application on behalf of the liquidator, the company being in liquidation. There were, he said, no assets, and the receiver for the debenture holders in possession had about £100 in hand. On the plaintiff's shares, £2,700 was unpaid.

Mr. Jenkins said he was going to suggest that the plaintiff was pursued by two gentlemen of the name of Redman, one a director of the company and the other not a director. He was told that the company was a flourishing concern, and was induced to apply for the shares. Yet at the very time he was doing so the company, so far from being in a flourishing condition, was being pressed by its principal creditor.

His Lordship agreed to the case going into the witness list.

Coalcutter in Gassy Mine.

Sheriff Fyfe, Glasgow, issued his decision on Friday in a test case against Nimmo & Co., claiming damages for an injured miner, at common law, or alternatively, under the Employers' Liability Act, in respect of an explosion, whereby two men were killed and several injured. The Sheriff dismisses the action as laid, reserving it for assessment, if need be, of compensation under the Workmen's Compensation Act.

In a note his Lordship examines the various statutory regulations, and concludes that the pursuer has not established any cause-and-effect relationship between negligence of the mine-owners and his injury, and so no claim at common law has been established; and that, even had it been, the claim is barred by the doctrine of common employment, the casualty having been proved to have been caused by the negligence of fellow workmen in failing to screw down the cover of the switch box of an electric coalcutter which was being used in the mine, and so permitting a flame to emanate from the coal-cutter and ignite the gas in the mine. The Sheriff finds that the coalcutter itself and its cable connections were in perfect working order, and that taking off the switch box cover and replacing it, as occasion may require, was not a skilled electrician's job, but an ordinary mechanical operation in using the coal cutter, the responsibility for doing which efficiently was with the machine men, as part of their duty of operating the machine. Upon the suggestion that a coal cutter should not have been used at all in the mine because of the presence of gas, the Sheriff says: "There is certainly no evidence in this case to support such a proposition; and I am, fortunately, not called upon to pronounce any opinion upon this very large question. I imagine it would be a very serious proposition for the coal industry in Scotland if it is to be regarded as unsafe to use a coal cutter, merely because there is more or less gas found in a mine. There are coal cutters specially designed for use in gassy mines, and the proof in the present case shows that the machine here in question was a flame-proof machine of modern type, and was in perfect working order."

Leave to appeal is granted, and it is understood that the case is regarded by the Miners' Federation as a test case, involving important questions as to safety in mine working, and that it will be carried to the higher court.

Application for Extension of Patent.

In the Chancery Division on Friday, January 27th, Mr. Justice Sargant heard a petition by Mr. Louis John Hunt and Sandycroft, Ltd., of 4, Broad Street Place, London, for an extension of a patent dated March 14th, 1906, No. 6,224, granted to the petitioners (Sandycroft, Ltd., being then known as Sandycroft Foundry Co., Ltd.), for "an invention of improvements in alternating-current dynamo-electric machines"; and also a patent of July 11th, 1906, No. 15,711, granted to them for "an invention of improvements in windings for alternating-current dynamo-electric machines." The first invention consisted of a single winding on the part of the machine to which the current was supplied, and the provision of tapping points in particular positions upon the winding for control purposes, the winding being so disposed that currents flowing through the tapping points would produce a field to a second number of poles required for cascade operation. The other invention was a machine with a stator winding of the type in the first invention, but with separate rotor windings, one of which was connected to a commutator so that the machine could be used as a converter for providing direct current through the alternating-current supply and vice versa.

Mr. J. Hunter Gray, K.C., and Mr. Whitehead appeared for the petitioning patentees, and Mr. Dighton Pollock and Mr. Trevor Watson for the Crown.

The merit of the inventions was not questioned by the Crown, and Mr. J. Swinburne described them as a distinct stage in the industry, a stage that had involved an immense amount of thought. Mr. Gray stated that the German patent, which was the equivalent of both the English patents, had been extended for five years on the ground of war-time losses.

His Lordship, giving his decision, said it appeared on the petition and was clearly proved by the evidence that there was a very great loss to the petitioners—Mr. Hunt and the company—owing to the war. He thought it would be proper in respect of that loss to allow an extension of four years, on the terms that the British licences now existing for the manufacture of the inventions were continued.

War Inventors' Claims.

Claims by Mr. Henry Leitner and Messrs. Joseph Lucas, Ltd., in respect of dynamos for use on aircraft, were heard by the Royal Commission on Awards to Inventors on January 30th. It was stated that over 5,700 of the dynamos were made for Service use. According to a witness it was the discovery, early in 1917, that German pilots were provided with electrically-heated clothing which led to the dynamo being evolved. The Commission reserved their award.—*Daily Telegraph.*

Is an Electric Truck a Light Locomotive?

The *Manchester Guardian* reports that a young man named William Halton, of Southport, has been summoned for driving along the public highway a motor vehicle, belonging to Electrical Vehicles, Ltd., Churchtown, without a licence, and when the case came before the local magistrates the Superintendent of Police stated that there appeared to be some doubt as to whether the vehicle, which was an electric truck, came within the definition of a light locomotive. In order that the local registration authority might communicate with the Ministry of Transport for a ruling on the point he asked for an adjournment. Last week the case was adjourned to enable a special line of defence to be prepared. A further adjournment was agreed to.

E

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Midget Masta" Fuse-Switch.

In our issue of April 22nd, 1921 (p. 509), we gave an illustrated description of the above appliance. The makers, Messrs. Berry's Electric, Ltd., 85, Newman Street, Oxford Street, W.1, now send us details of some improvements which they have effected in its design. The principal difficulty encountered in the use of small apparatus such as this switch-

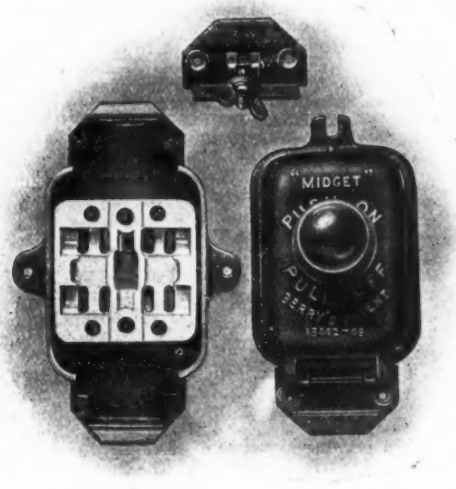


Fig. 1.—The "Midget Masta" Switch Fuse, showing Cover Removed.

fuse is the lack of space for connecting up wires after conduits are fixed. The casing of the "Midget Masta" has, therefore, been altered to enable the complete removal of the whole of the top cover by the taking out of four screws, which renders available a sufficient amount of space for making connections. The idea is illustrated in fig. 1.

The "Hot-Spot" Boiling Ring.

We have received from Messrs. Rich & Bundy, 11a-13, New Road, Ponders End, N., a sample of their "Hot-Spot" electric boiling ring. The most noticeable feature of this appliance is its small weight, for although it is 8 in. in diameter and 3 in. high, it weighs only 6 lb. The element is a continuous spiral of high-resistance wire in eight rows threaded through metal-stiffened mica strips. The holes through which the wire passes have metal eyelets which prevent damage to the mica. The top is formed by wires passing through the

Fig. 2.—A "Hot-Spot" Boiling Ring.

tops of the metal-stiffened mica strips. Beneath the element is a highly-polished reflector. A separate plug is supplied for each lead.

This boiling ring is one of a series being made by Messrs. Rich & Bundy, the loadings ranging from 600 to 1,000 W. Although made primarily for standard pressures, the rings can be supplied for connecting to low-voltage circuits.

A Pocket Electroscope.

About the middle of last year two Danish engineers, Messrs. Johnsen & Rahbek, demonstrated at the Institution of Electrical Engineers a new, or re-discovered, electrostatic phenomenon. It was shown that when two metal plates, between which was placed a semi-conducting stone, were connected in a direct-current circuit, the passage of electricity set up a strong adhesive force between the plates and the stone. Several applications of this principle were shown, and among them was an ingenious pocket electroscope. The principle of the device is illustrated in fig. 3 (which we reproduce from the *Scientific American Monthly*). The semi-conductor in this case is gelatine (1) spread in a uniform layer over a slightly curved metal strip (2). One pole of the electric circuit is connected to this strip, while the other is joined to an elastic strip of aluminium foil (3), whose lower end is kept in contact with the gelatine. A potential difference of sufficient strength between the two poles will cause the aluminium strip to come into contact with the gelatine, as shown by the dotted line (4). The application of this movement in the finished electroscope is shown in fig. 4 (also from the *Scientific American Monthly*). Here the stiff metal strip is that portion marked (2); (3) is the gelatine covering. These are fixed to a metal upright (4), screwed into an ebonite tube (5), which is connected through a resistance (6) to a metal point (7). The aluminium-foil leaf (3) is connected electrically to an exposed metal casing (9) by means of a curved contact spring (8). The instrument is used as follows: If it is desired to ascertain if a potential difference exists between a conductor and earth the exposed metal casing (9) is held between the fingers and the metal point (7) is placed upon the conductor. If a current is flowing the metal foil will be attracted, and this is indicated by means of a little shutter (11), which appears at the opening (10) in the top of the instrument. The apparatus is so sensitive that a good connection to earth through the body is immaterial. The electroscope can be discharged by placing the point on one hand while the metal top is held by the other. It will be seen that the instrument may be put to a variety of uses; for instance: for earth tests; potential difference tests; to detect "live wires" or surface leakage; for discovering faults; and for many other purposes which will readily occur to the reader.

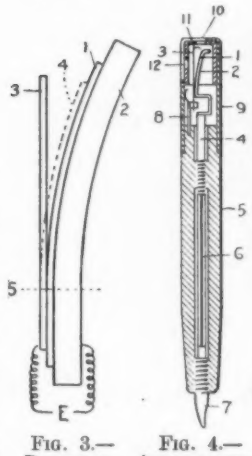


Fig. 3.—Principle.

Fig. 4.—Arrangement. Pocket Electroscope.

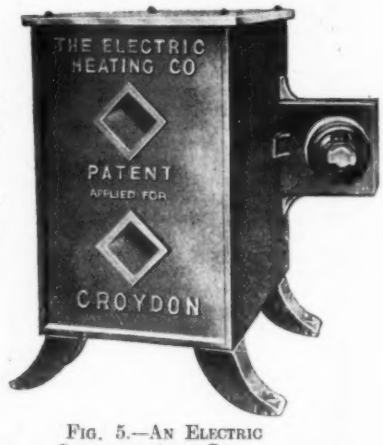


Fig. 5.—An Electric Soldering-Iron Stove.

Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C., who are the British agents for the device, inform us that the electroscope can be used for any pressure between about 80 and 700 V. either d.c. or a.c. The instrument is made to resemble, in size and shape, an ordinary fountain pen.

An Electric Soldering-iron Stove.

In our issue of September 16th, 1921 (p. 372) we described an electric stove made by the Electric Heating Co., George Street, Croydon, for the purpose of heating soldering irons. This has recently been entirely redesigned, as will be seen from the illustration fig. 5.

The capacity has been reduced, the stove previously described having accommodation for four irons, whereas the new design provides for two. The stove is strongly constructed of cast iron, and weighs about 50 lb. It is well lagged and provided with a three-heat switch, giving a maximum load of 1,000 W. The first pair of irons can be heated ready for use in 15 minutes, after that three minutes suffices for each iron. As the elements are entirely enclosed the stove can be used with perfect safety in garages, oil refineries, &c.

A Combined Electric Heater and Fan.

Mr. V. Gillgan, 58, Bloomfield Avenue, Belfast, informs us that he has secured provisional protection for a combined electric heater and fan. The heating portion consists of seven elements controlled by a dial switch: the fan is in parallel with these elements (separately switched), and is so situated that it draws air through the device over the heating elements and expels it through the front of the apparatus. The whole of the gear is contained in a sheet metal casing.

CORRESPONDENCE.

Letters received by us after 5 p.m. on TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Utilisation of Waste Heat.

As I had no opportunity of making any comments on the interesting papers of Mr. Ingham Haden and Mr. Whysall at the joint meeting of the Institution of Electrical Engineers and the Institution of Heating and Ventilating Engineers held on January 19th, I ask for the hospitality of the columns of the ELECTRICAL REVIEW in which to do so.

Mr. Haden's paper sets out the principles of the subject of the utilisation of waste heat from steam-driven plant very clearly, and though one may agree with his general conclusions, I am disposed to differ from him on certain points of detail. For instance, Mr. Haden is clearly of opinion that in general the medium for transmitting heat for distribution should be superheated steam. I feel confident that it will be found that in the majority of cases water will prove to be favoured for the purpose. Generally speaking, I think it will be found that the low-temperature requirements in a district will outweigh those of special industrial operations such as paper making, sterilising, and so forth, for which special boilers would be suitable. The advantages which water, as a medium for heat transmission, possesses over steam should not be lost sight of—its high specific heat, the ease with which air can be liberated from high points in water mains compared with the difficulties attendant upon freeing steam mains of water, the reduced heat loss per unit surface from the mains, and the absence of the necessity to work the steam plant supplying the heat against a back pressure. The metering difficulty arising when water is used will without doubt be solved by the production of a B.th.u. meter when the need for this is shown.

Where district heating is contemplated in conjunction with the utilisation of the waste heat on the lines discussed by Mr. Haden, the feasibility of the scheme naturally turns upon the practicability of getting mains along the streets, and a concrete case requires investigation from this point of view and also from the £.s.d. point of view. Furthermore, the price to be charged for heat units would have to be an attractive one wherever an ordinary gas supply was available.

The two diagrams (figs. 1 and 2) shown by Mr. Haden in his paper are of great interest and clearly illustrate the questions involved, notwithstanding that the load curves are hypothetical.

Fig. 1 shows the winter load conditions of working, and the case is obviously one where the waste heat from the electrical machines can be, and should be, utilised to the utmost. The heat requirements far outweigh the electrical ones, and as the whole of the heat from the exhausts of the electrical plant can be made use of to serve the heating load, obviously it would be useless to endeavour to get the electrical units turned out with maximum thermal efficiency of the generating plant. The condensing plant should be shut down and the engines run as simple engines, or as two or three-stage, as the case may be; and as long as the machines are able to supply the maximum electrical load and the exhaust steam is not more than that required to meet the heating load, they should be so run. If they are unable to supply the electrical peak load, then the condensing plant would be run for a couple of hours or so, or other provision made to meet the peak load.

It should be borne in mind by the station engineer that he is not restricted in his electrical output by the demands of the heating load. Assuming water distribution of the heat, it makes comparatively little difference to the heating plant whether the heaters are fed with steam at boiler pressure or at atmospheric pressure, hence whether or not the steam engines or turbines are interposed in the passage of the steam from the boilers to the heating plant is not material. The engines virtually act as pressure-reducing valves, and in so doing use up a comparatively small portion of the heat in the steam in giving out power in the electrical form. The heating plant makes use of the latent heat of the steam, otherwise to be got rid of by the circulating water in the condensing plant. Hence the economy of the proposal of the combined station.

When we turn to fig. 2, showing summer conditions of working, the problem presented is of a different order. Here the electrical requirements exceed the heating at times, and at such times maximum economy of generation of the electricity is important. Under these conditions, condensing would be resorted to where condensing plant was installed, though in the case of a new station it is doubtful whether interest and sinking-fund charges and cost of running the plant would justify the provision of such condensing plant for the comparatively short periods when it would be required. Nevertheless, as much as possible of the exhaust of the engines should be directly made use of in the heating plant and be diverted thereto on its passage to the condensers, the heaters of the heating plant aiding in the condensing operations, being virtually surface condensers with independent circulating water, the heat in this last being usefully employed.

The condensing plant would under these last conditions of working probably be run throughout the 24 hours, and this brings us to the question as to the best means of driving the condenser auxiliaries. It would appear that they should be steam and not electricity-driven, for the reason that the exhausts from them can be directly utilised in the heating plant, thereby getting the steam power most economically, and that electrically-driven auxiliaries at light load (and even full load) cannot be so economical under the conditions of working in a combined station.

This last argument would possibly not hold good during periods when the electrical load outweighed the heating, but during such periods steam-driven auxiliaries would exhaust to the condensers; and throughout the winter loads the argument would hold good.

It is probable that the existing condensing plant of an electrical station should be permanently utilised as part of the heating plant, the circulating water for distribution in the district being passed through the condensers in place of the ordinary river or other water. The circulating pumps should then, undoubtedly, be steam-driven, preferably by turbines with their clean exhausts.

The subject of the utilisation of waste steam is one of great interest and importance, and deserves the careful consideration of all those responsible for the installation and running of steam plant.

H. E. Mitchell.

January 24th, 1922.

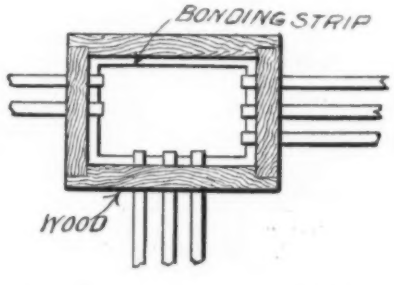
The Durability of Lead-covered Wire.

Referring to the correspondence in recent issues of your paper on the subject of lead-covered wiring, or, as I should prefer to call it, metal-sheathed, since the coverings are generally stated to be alloys, my experience may be of some interest to your readers at home.

I have at present in my charge in Calcutta 199 buildings wired in one or other of the metal-sheathed systems. These buildings are variously used, and consist of offices, private dwelling-houses, prisons, tanneries, museums, libraries, post-offices, and printing presses. They have installed in them 4,700 110-watt ceiling fans, 12,000 lights, 20 lifts, 90 pumping sets, and a number of motors.

The oldest installation in the lead-alloy sheathing is nine years' old, and is apparently in good condition now. I have little trouble with the installations, but occasionally during the rainy season (temperature 85-90 deg. F., and humidity in the nineties) I have leakage, which, however, causes no damage to the sheathing provided my earth connections are in good order; if they are not then I find rapid deterioration in the metal covering.

The test for "earth" resistance is fairly stringent, the "earth" having to pass ½ ampere at 4 volts from any point in the building. Bonding is generally carried out by means of a strip of metal folded on itself in the form of a square,



and wood connecting boxes are used instead of the metal ones supplied by the makers, as it is found that the metal covering deteriorates at the point of junction when the metal boxes are used.

In very damp places, or where the plaster is likely to get damp and remain so, the metal-sheathed wire is run on small strips of well-varnished teak wood, the varnish used being a water-proof varnish.

I find the following are the essential points to watch:—

1. Earth wires being in good order.
2. Bonding being perfect.
3. Patches forming on the walls where leakage is taking place must be attended to at once.

Out here we never bury any wiring work, as it would not last unless the plaster could be kept absolutely dry. Insulated conduit has been buried, but the only installation I have had under me had to be given up, as white ants took to the tubing and filled it up solid, at the same time destroying the insulation of the wires and tubing.

I am satisfied with the lead-alloy metal-sheathed wire sufficiently to change over all my old casing installations as they require re-winding.

The supply voltage here is three-wire 225-450 volts, and in all my large buildings I am now having iron-clad main, sub-main, and distribution boards to ensure all metal parts being properly earthed. I also see that in large buildings all boards

carrying 50 amperes or over have separate earth-plates for each 50 amperes.

Systems of metal sheathing other than lead have been tried and abandoned, as they have not stood up to the work required of them.

All our bells are wired on the metal-sheathed system and the bells worked on the 220-volt circuits, being shunted across a resistance in series with a 220-volt lamp.

Battiwallah.

Calcutta.
January 12th, 1922.

Change-over from D.C. to A.C. Supply.

With reference to the correspondence in connection with the change-over of lead-covered single-core cables from d.c. to a.c., it is practically certain that the induced currents in the lead sheaths will cause trouble. The burning of the sheaths which ensues is not so much due to the volume of these secondary currents perhaps, as to the nature of the contact between the sheaths. In many cases the area of contact is merely a point or, at best, a thin line where the two cylindrical lead coverings are in contact for a short distance. The result is a high current density at these points, which causes damage sooner or later.

The writer has had experience of this effect in the case of three low-pressure single-core 1-sq. inch l.c. and a. cables, these cables having to be used owing to circumstances beyond his control. Originally the cables were laid in a trench between a transformer and the main l.p. switchboard, the system being 440 volts, 3-phase. Trouble, which was more or less anticipated, soon manifested itself, the armouring at one point reaching a dull red glow. The cables were eventually run on racks.

So far as I am aware it is not possible to get rid of these sheath currents except by insulating each cable sheath along its whole length, as was done in the case just cited. Frequent bonding along the cables would probably increase the trouble instead of alleviating it, and I should consider that it would be far more satisfactory if "Mains" replaced his cables by a three-core one—and perhaps it would be less expensive in the long run.

Salfordian.

January 24th, 1922.

The Magnetic Screening of Cables.

With reference to "Hardly Convinced's" letter on the above subject, may I state that I agree with the text-book for the following reason:—

The lines of force set up by a current flowing in a cable take the form of circles, as also does the iron tube, whose reluctance is less than that of the air, with the result that the flux crowds into the tube, leaving the surrounding air comparatively screened.

Of course, if a thin tube is used, and a heavy current in the cable, the screening may not be very great.

I agree with "Hardly Convinced" that the subject has been avoided, but is it not fairly obvious without having any reference made to it?

Screened.

January 30th, 1922.

[We venture to differ from our correspondent. The magnetic field set up by a current in a long straight conductor is certainly not restricted to a coaxial iron tube and the space inside the tube. The tube has no magnetic screening effect at all.—EDS. ELEC. REV.]

Your correspondent "Hardly Convinced" has questioned the accuracy of H.M. Stationery Office's pamphlet in its statement that:—"If a cable carrying a current (constant or variable) is enclosed in a tube of steel or iron, the external magnetic field is appreciably reduced. The space external to the tube is said to be 'screened.'"

Apparently both "Hardly Convinced" and H.M. Stationery Office are right and both are wrong. All depends on how the enclosing metallic tube happens to be connected.

If the problem be telegraphic with the tube (or cable armature) earthed, magnetic screening will be effective, as H.M. Stationery Office maintains. But if the tube be insulated, magnetic screening will not be present, and "Hardly Convinced" will be right.

Likewise, if the problem be local, and both ends of the tube available; if the two ends be connected, and the resistance of the connection be *nil*, screening will be effective. If, on the other hand, the tube be left insulated with its ends disconnected from each other, screening will not occur.

This matter has been investigated by the present writer in his booklet* "The Two-Tone Vibrating Transmitter and Cable Inductive Signalling," (Pp. 19-24) mainly a reprint of the writer's articles published in *The Electrician*, of December 18th, 1908, and January 15th, 1909.

The investigation in question related to the system originated and developed by the present writer—with cordial co-operation of friends ashore and afloat—to enable a cable-repair ship to keep up inductive telegraphic communication with the shore (under certain K.R. limitations) during the making of a final cable joint and splice.

The present writer ventures to enclose two copies of his booklet respectively for yourself, sir, and for your correspondent "Hardly Convinced."

This little book has the advantage of being included (a minnow among whales) in the library of the I.E.E.

The various apparatus mentioned in the booklet are made in the "Silvertown" Co's. Instrument Department.

E. Raymond-Barker.

Kensington, W.
January 30th, 1922.

*Withdrawn from publication with a view to subsequent re-issue with additional matter.—E.R.B.

A Notice to Callers.

I am in no way connected with the electrical industry.

I happened to casually pick up your January 27th issue, at page 121, and saw what you are pleased to refer to, as a "business-like notice," by the buyer of Messrs. Simplex Conduits, Ltd.

I can imagine the Commissionaire at Garrison Lane, waving away the queue of travellers at 4 o'clock on a Thursday afternoon, and telling them to come back next Tuesday morning at ten o'clock.

Supposing, for argument's sake, every buyer in your industry erected a similar notice, Messrs. Simplex Conduits, Ltd.'s own travellers would not have a very busy time, as they could not put in ten-and-a-half hours a week in the actual interviewing of customers, but, on the other hand, they could have some very fine week-ends.

I cannot think he is a very keen buyer, who causes such a notice to be put up.

Men with good lines to offer, at keen prices, would push on and sell to the man who will see them at any reasonable business hour, from Monday to Friday. Whereas, the man whose prices are high, will pick out the indifferent buyer, as a man very loath to see travellers, and sell to him by subserviently attending at a certain hour on a certain day.

A buyer worthy of the name should be open to see anybody, at any reasonable hour, and should be able to shut down the time waster immediately.

In my own particular business, buyers will see travellers at all times, any day, as they are most keen on a good line, and a bargain.

These arbitrary notices cut both ways, and I think we should all be very sorry indeed to see them become general.

C. J. Docherty.

Bristol,
January 28th, 1922.

A Correction.

We notice on page 131 of the issue of the ELECTRICAL REVIEW, January 27th, that Mr. Whitmore has severed his connection with the Walsall Electrical Co.

We would like to point out that we have no trace of Mr. Whitmore being in our employ. On the other hand, the writer attends to all London business, and can be seen at any time in London by appointment or on Tuesdays at the Engineers' Club, Coventry Street, London. Our business is carried on in other parts of the country through recognised wholesalers.

J. Delebecque,
For the Walsall Electrical Co., Ltd.

Walsall.
January 30th, 1922.

[We regret to learn from our informant of last week that in error he used the name Walsall Electrical Co. instead of Walsall *Hardware* Co.—EDS. ELEC. REV.]

The Stiffness of Poles.

Replying to Mr. G. V. Twiss's criticism, in your current issue, of my article on the above subject which appeared in your issue of January 6th, at the end of the article the following statement will be found:—"(2) The flexibility of the poles will determine whether the tension is reduced to the necessary extent by deflection, or by slipping of the binders."

In the calculated example this slipping was ignored, because the loads found were not such as would be likely to cause slipping.

With regard to the relief given to the unbalanced pull due to torsion, this relief is only afforded if more wires break at one end of the arms than at the other end. If two wires break at opposite ends of the arms, or one wire carried centrally on the poles, there will be no relief due to torsion.

Mr. Twiss's recommendation that the strength in the line direction should be one-third of that in the direction transverse to the line is probably a safe rule for long spans, because in long spans the tension cannot possibly be reduced to the necessary extent by deflection, and slipping must occur. In such cases the maximum possible load in the direction of the line will be the sum of the loads which the binders of the broken wires can sustain, plus wind pressure on the pole. This may be one-third of the transverse load in a particular case, but if the span were halved or doubled, the ratio would become two-thirds or one-sixth respectively. It is a little un-

fortunate that in the cases referred to by Mr. Twiss the same fraction should represent both the assumed proportion of broken wires and also the ratio of longitudinal strength to transverse strength, which has been found satisfactory, because it may lead to the supposition that these are in some way connected. They have nothing whatever in common except an accidental equality in a particular case.

This will be obvious if we apply the ratio one-third to a moderate span. Here the wind pressure on the pole load itself may be 50 per cent., or even more, of the total transverse load, and therefore, if the ratio of one-third were adopted, the poles would not only be unable to sustain any longitudinal line load, but would actually depend upon the support afforded by the wires for their stability.

Gower B. R. Pimm, Assoc.M.Inst.C.E.

London, S.W.
January 31st, 1922.

Proposed Emigration.

Referring to the letter in your issue of January 28th, p. 142, I should like to give a bit of advice to "Inquirer" about work and conditions in South Africa. Before I go any farther, I should just like to tell him straight away: "Don't go!" for if things are bad here, they are infinitely worse there. When I came through Capetown the first week of November there were about 5,000 white men out of work, and about 3,000 were on relief works, working alongside a lot of niggers for 5s. 6d. a day, and glad to get it; men of all descriptions, tradesmen, clerks, and others, respectable well-doing people. Business there is at a dead end. When I landed at Capetown, which was a few months before, I stayed a day to find out things, and the same conditions prevailed.

I left Capetown at night for Johannesburg; the journey takes two nights and two days, travelling all the time. The railway fare is £6 0s. 6d. single; bedding cost 3s. 6d. for the journey; breakfast, dinner and lunch cost 11s. 6d. per day; expenses for this journey, £7 7s. You land in "Jo'burg" at 8 p.m., then have to find digs., and the cheapest I could get was 4s. 6d. a night—"bed only." Breakfast, dinner and tea were 7s. 6d. extra. You will see I am not allowing for any extras, such as a bottle of beer, or a nip of Johnny Walker. As I didn't indulge in these luxuries, I can't speak about them. All the better for any white man to keep away from drink in that country, because it either kills him or puts him into the asylum. I am putting "Jo'burg" first on the list, because it is the largest town.

The Corporation owns the electricity department and tramways, and if a man can get in there he is mighty lucky. I fancy he will want a friend who wears a size 15 boot, and can kick like a horse.

There is a large firm of electrical engineers in "Jo'burg," Messrs. Hubert Davies & Co., but there wasn't much doing; also the G.E. Co. and Bruce Peebles & Co., who, as far as I could see, have only agencies, besides smaller contracting firms. At that time there were about 7,000 white men idle, with prospects of things getting worse, and the same condition of affairs applies to Durban. Durban is 500 miles from "Jo'burg," a day and a night's travel by train; fare £3 10s. single.

The Victoria Falls Power Co. has the monopoly of trade, supplying the Rand from east to west from three large power stations: Rosherville, Germiston, and Vereeniging (the last about 40 miles away). The electricity supply is 3-phase, 50 cycles, 5,000 volts, transformed up to 50,000 volts for long transmission, and down to 110×220 for lighting and power.

All mains for household lighting, in the suburbs, Cleveland, Germiston, Boksburg, &c., are overhead, with transformers stuck on the same standards as the mains; tappings are taken off anywhere most convenient, generally running through the roof of the house or the side—a proper conglomeration of wires. I will now give an idea of what a white man has to go through before he gets a job on the mines. He has to go before a medical board of three or four doctors, called the Miners' Phthisis Board, pass an X-ray test for tuberculosis, and has to be practically physically fit in every way. He will get the result of his examination in about five days. If he gets a red card, he can work either under or above ground, but if he gets a green card, he can only work on top, and there are hundreds that can produce only a green card; so, my friend, if you want to try the mines, make sure before you leave this country that there are no germs in your lungs—a fact that should be well known to all intending emigrants.

Experience is the best teacher, and anyone going to Africa with the idea of picking up diamonds, or gold, or better still, a job in the meantime, will soon wish Africa and everything else in *Gehenna*.

The best age for anyone to go to Africa would be from 18 to 25, because he is better able to stand the heat, the conditions, and the food, and that is the main point; the Dutchman would live where the Britisher would go under, and for spinning the tale he can beat the band. I always thought Americans could boast, but they can't hold the candle to any Britisher that has been there for 10 or 12 years. If you want the truth of any of the colonies, trade or prospect, write to the Minister for Foreign Affairs, London—another item the people of this country should know.

The country of Rhodesia is even hotter than the Union, and trade there meantime is at its lowest. The two principal towns are Bulawayo and Salisbury; the whites in Bulawayo number about 5,000. The principal electrical places there are the railway—no good at present—the waterworks and the power station, a private concern, single-phase, 125 cycles, 2,000 volts, with three machines, one of 75 kW, and two of 150 kW, transformed down to 110×220 volts for lighting and power. The plans have been passed by the town for a new station, but it will be 12 or 18 months before new plant can be put in, pipes run for water, the nearest point being three miles away, and all other details connected with a power station. Then there is the question: Can they run it cheaper than the existing waterworks plants? If I remember aright, the price per unit at present is 1s. 2d.; that means that the town will have to run cheaper, so that people won't be annoyed at changing over. I think the estimated cost of this job is about £50,000, and in my opinion it is a waste of money for the citizens of Bulawayo.

I see the Editors refer to this on page 123. Salisbury is a smaller town, though the capital of Rhodesia, and the white population is somewhere about 4,000. Just one street there is of any consequence, and the electric plant is much smaller than at Bulawayo. Umtali was the headquarters of the railway workshop, but that is all shifted to Bulawayo now, so Rhodesia for the next 18 months is no good. Wages in Rhodesia are 3s. 9d. per hour, board and lodgings about £3 or £3 5s. per week, all extras over and above. Mafeking is a good-sized village, about ¾-mile square; no electric light here. Bloemfontein is a nice-sized town, very healthy, and has electric light, but is no good as regards electrical work. Kimberley, the diamond centre, belongs to the De Beers Co., and has electric light and tramways, but at present is practically dead; the last account that I heard while coming through was that there were only about 200 working in the town. These are the principal places in South Africa regarding electrical work.

Wages in Cape Colony vary from 3s. to 3s. 9d. per hour, but I expect by now they are down to 3s. maximum rate, owing to trade troubles. There is no electrical Trade Union there; electrical work comes under the A.E.U.

Before an emigrant can land in South Africa, he has to have £20 landing money. Then there are the emigration officers to pass, and they are more strict than in this country, so if a man goes out on spec. with only £20 and no job, one month will swallow up his little Klondyke; then there is nothing but Shanks's pony.

Australia I can't speak of, but I came in touch with a lot of people travelling back and forth, and that country is far worse, practically nothing doing at all.

I hope this may give "Inquirer" and others a little idea regarding conditions abroad; one knows where one is here, but out there it is a case of roughing it all the time, and no money, no friends. This is how I found things in my travels through South Africa.

Chas. Crutcher.

Aberdeen.
January 29th, 1922.

[We are much indebted to our correspondent for his spirited and comprehensive letter; he has a gloomy tale to unfold, but he tells it almost cheerily.—Eds. Elec. Rev.]

Charging for Services.

Could you or one of your many readers clear up the following point?

I have always understood that it was compulsory for supply authorities to run service mains into consumers' premises up to and including a distance of 60 ft. free of all cost to the consumer.

The war has apparently changed many things, and to-day contractors are finding many supply undertakings making a charge for even very short service lines. I have been given to understand that this is illegal, and have looked up several lighting orders, which appear to confirm this view.

Now that "Dora" is supposed to be dead, can the supply authorities be compelled to run in services free?

Undoubtedly the charges for these services are a stumbling-block in the way of contractors.

A Contractor.

January 30th, 1922.

[Electricity supply undertakers must give a supply to premises within 50 yards of any distributing main used for general supply. Undertakers who refuse to make a connection must state the reason, under penalty. The cost of a line laid on private property must be paid by the consumer, but the cost of a line not on private property, up to a distance of 60 ft., must be paid by the undertaker. Full particulars are given concisely in the "Electrical Contractor's Year Book" (Electrical Contractors' Association, Inc.).—Eds. Elec. Rev.]

Tramcar Invention.—The L.C.C. has granted permission to Mr. W. E. Ireland, the rolling stock engineer in the Tramways Department, to take out a patent in respect of his invention for a new type of combined folding step and side lifeguards for tramcars, subject to the condition that the Council shall be allowed to use the patent without payment of royalty should it so desire.

BUSINESS NOTES.

Our Half-Yearly Index.—The Index to Vol. 89 of the Electrical Review, which is now ready, will be supplied to those who, through the post, specially apply for it. To such it will be supplied for 6d., post free. Any reader or advertiser, at home or abroad, who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to the Publisher, Electrical Review, 4, Ludgate Hill, E.C.4.

Bankruptcy Proceedings.—A. J. Willcox, motor and electrical engineer, The Garage, Farnham Common, Bucks.—Trustee (Mr. F. W. Davis, 28, Theobald's Road, W.C.1) appointed January 25th.

T. D. Waring, electrical engineer, 55, Walmgate, York.—First and final dividend of 8s. 11d. in the £, payable February 6th at the Official Receiver's Offices, Duncombe Place, York.

Edward G. Langsford, electrician, of 74, Westgate, Burnley.—At Burnley Bankruptcy Court, on January 26th, this examination was adjourned. The gross liabilities were £410, and there was a deficiency of £396. Bankrupt attributed his failure to ill-health. Whilst following his occupation as an electrician in the mill, debtor had an accident, for which he received £40 compensation. With this money he set up in business on his own account. Just at that time he was called to the Army, but through ill-health was discharged. He was questioned about various debts.

P. Rothwell (trading with P. A. Rothwell, a minor, as P. A. Rothwell & Co.), electrical engineer, 64, Higher Bridge Street, Bolton.—First meeting, February 8th, at the Official Receiver's Offices, Byrom Street, Manchester; public examination, February 15th, at the Court House, Bolton.

J. V. Figgins, electrical engineer, 3, Pottery Terrace, Alexandra Road, Newport.—First meeting, February 9th, at the County Court Office, Newport; public examination, March 14th, at the Town Hall, Newport.

C. P. M. Downie (P. Downie), electrical engineer, 355a, Westborough Road, and 88, Ronald Park Avenue, Southend-on-Sea.—First and final dividend of 4s. 9½d. in the £, payable at the Official Receiver's Office, 29, Russell Square, W.C.

T. Hyde, electrician, 180, London Road, Croydon.—First and final dividend of 1s. 9½d. in the £, payable February 15th at 29, Russell Square, W.C.

Company Liquidations.—Planet Electric Co., Ltd., St. George's Road, London, S.E.—The creditors were called together recently at the offices of Messrs. Dollman & Pritchard, 52, Tavistock Square, London, W.C., when it was stated that the shareholders had passed the usual resolutions for voluntary liquidation, and had appointed Mr. S. H. Swallow as liquidator. An approximate statement of affairs was presented, which disclosed liabilities of £1,177, of which £877 was due to the trade. The assets were estimated to realise £918, or a deficiency of £259. The assets consisted of: stock estimated to realise £350; good book-debts, £350; furniture, fittings, and lighting installation, £160; plant, £55; and cash in hand, £3 3s. 8d. It was reported that the company was registered some three years ago with a nominal capital of £2,000. The issued capital was £1,908, of which £1,246 was subscribed for in cash. The last balance sheet was prepared as at June, 1921, and disclosed a loss of some £600. Eventually a resolution was passed confirming the voluntary liquidation, with Mr. Swallow as liquidator, while a committee was appointed consisting of the representatives of Messrs. Rose Bros., Ltd., Lion Engine Co., Ltd., Telga Co., and Fuller's United Electric Works, Ltd.

Stockwell & Ohms, Ltd.—Winding up voluntarily. Liquidator: Mr. H. Holmes, 2, Fenchurch Avenue, E.C.

Falksley Electrical & Cinema Supplies, Ltd.—Winding up voluntarily. Liquidator: Mr. A. E. Sisling, 9, Clinton Street West, Nottingham.

Castlerea (Roscommon) Electric Lighting and Milling Co.—This company has decided to go into voluntary liquidation, not being able to meet its liabilities.

Diesel Engine Co., Ltd.—Particulars of claims to the liquidator, Sir W. B. Peat, 11, Ironmonger Lane, E.C., by February 28th.

Rotary Ignition, Ltd.—Meeting March 6th at 1 & 2, Great Winchester Street, E.C., to hear an account of the winding-up from the liquidator, Mr. F. Morse.

Patent Plug Co., Ltd.—Meeting of members called for March 2nd at the office of Mr. A. M. Sillar, 104, Victoria Street, S.W., to hear an account of the winding-up from the liquidator, Mr. R. B. Young.

Trade Announcements.—The London Electric Stores, having had to take larger premises, have removed to 23a, Oxendon Street, Haymarket, S.W.1 ('Phone: "Regent 5086").

Messrs. P. H. Boys & Co., of 187, Goswell Road, London, E.C.1, who are specialising in the rewinding and repair of generators and motors and electrical apparatus, have issued a handy vest pocket card calendar for 1922, with postal and other information on the reverse side.

Messrs. William Jacks & Co., metal merchants, have removed to Winchester House, Old Broad Street, E.C.2, owing to the re-building of East India Avenue.

The Visco Engineering Co., Ltd., has appointed the following sole representatives for the districts mentioned:—Mr. F. J. Rynd, of Motor House Chambers, Wood Street, Cardiff, for the South Wales district; Mr. C. J. Sellar, of 144, St. Vincent Street, Glasgow, for Scotland; and Mr. P. S. Thompson, of 99, Albert Road, Middlesbrough, for the North-East Coast.

Mr. G. Hetherington, having started in business as an electrical factor at 82, London Road, Carlisle, wishes to receive factors' prices of all accessories, conduit, cable, &c.

The Electro-Mechanical Brake Co., Ltd., of West Bromwich, has now opened London offices at Donington House, Norfolk Street, Strand, W.C.2, with Mr. W. F. Knight in charge. Telephone No. 1888 Central.

The business of Hudson's Electrical Engineering Co., Ltd., has been purchased by Mr. Chas. W. Holman, A.M.I.E.E., who will continue it on the same lines and at the same address, viz., 7 & 8, Prudential Buildings, Park Row, Leeds.

Messrs. Simpson, Baker & Co. are removing on February 6th to more commodious premises at 2 to 5, Nelson Street, Bristol, where they will have a large showroom for the use of the trade only.

The "Easy-Fix" Fittings Co., 66, Victoria Street, London, S.W. 1, is being re-constructed, and in future it will be carried on under entirely new management. The company desires to receive manufacturers' price lists and catalogues, as the new company will be dealing with all electrical requirements.

Catalogues and Lists.—The General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.—Catalogue Section X (4), giving illustrations and particulars of condenser protective gear for dissipating voltage surges.

The Jeary Electrical Co., Ltd., 8, Lambeth Hill, Queen Victoria Street, E.C. 4.—An illustrated pamphlet advertising the "Jeary" electric suction cleaner.

The B.E. Co. (of London and Birmingham), Ltd., 57, Upper Thames Street, E.C.4.—An illustrated and priced leaflet describing the "J.H.M. Perfecto" 10-A, d.p. time switch.

Mr. E. W. Dorey, A.M.I.E.E., Norwich House, Southampton Street, High Holborn, W.C. 1.—An illustrated leaflet giving some particulars of the "Atlas" one-cylinder type pass-out engine.

Messrs. L. G. Hawkins & Co., 116, Charing Cross Road, W.C. 2.—A letter-folder illustrating a number of "Miller" electric lighting fittings, and a pamphlet giving illustrated details of "Universal" domestic appliances.

Materiel Electrique Alex. Lefebvre, 9, Rue Arsène Houssaye, Paris (8me).—A list of plant for sale, including steam turbo-generators, reciprocating engine sets, and electric motors.

Electrical Utilities, Ltd., 1-3, Shelgate Road, S.W. 11.—Leaflet LF/1, illustrating and describing the "Utility" combined current limiter and fuse box. Priced.

Mr. Charles Selz, 83, George Street, Baker Street, W.1.—A pamphlet giving coloured illustrations of silk shades of many types; a leaflet dealing with a combined trinket set and electric light; and an order card.

Messrs. Ruston & Hornsby, Ltd., Lincoln.—A well-illustrated booklet (No. 4,213) describing in detail the construction and working of "Hornsby-Stockport" gas engines and suction gas producers.

Wright Motors, Ltd., Century Works, Halifax.—Lists Nos. 57 to 60, giving illustrations, prices, and particulars of single-, two-, and three-phase induction motors.

Messrs. Oldham & Son, Ltd., Denton, Manchester.—A series of illustrated leaflets giving particulars and prices of "Oldham" special process accumulators.

Messrs. Mavor & Coulson, Ltd., 47, Broad Street, Mile End, Glasgow.—Twenty-three illustrated leaflets dealing with numerous types of ironclad switch and fuse gear, cubical-type switchboards, controllers, &c.

Messrs. Wm. Geipel & Co., Vulcan Works, St. Thomas Street, S.E.1.—An illustrated leaflet describing a new type of d.c. motor starter. Priced.

The Edison Swan Electric Co., Ltd., Ponders End, Middlesex.—A pamphlet advertising "Ediswan" dry and inert batteries; and Leaflet No. LL. 220, giving prices of "Royal Ediswan" gas-filled lamps.

Book Notices.—"Mathematics for Engineers," Part 1, by W. N. Rose. Pp. xiv.+514; 257 figs. London: Chapman and Hall, Ltd. Price 10s. 6d. net.

"*Journal* of the American Institute of Electrical Engineers," Vol. XLI, No. 1, January, 1922. New York: The Institute. Price $1.

"Fuel in Science and Practice," Vol. I, No. 1, January, 1922. London: The Colliery Guardian Co., Ltd. Price 10s. 6d. per annum.—This is the first appearance of a monthly journal which is described as "a journal of the scientific and economic uses of fuels (being the record of the Coal Research Club)." As Sir George Beilby remarks in a "foreword," there is room for a publication of this nature to secure complete knowledge and co-operation in the economical use of fuel. As may be surmised from its source, the journal is principally devoted to the employment of coal, and a number of practical and technical articles appear in the initial issue, including "Producer Gas from Pulverised Fuel," by F. S. Sinnatt and L. Slater; "Coal and its Carbonisation," by S.

Roy Illingworth; "The Study of Mineral Matter in Coal," by R. Lessing; and "Resins in Bituminous Coal," by R. V. Wheeler and R. Wigginton. The new journal is under the joint editorship of Drs. R. V. Wheeler and J. V. Elsden, of the *Colliery Guardian*.

Copper, Lead, and Platinum Prices.—Messrs. F. Smith and Co. report. January 31st: Copper (electrolytic) bars, £72 5s., 15s. decrease; ditto sheet, ditto wire rods, £85 15s., 5s. decrease; ditto h.c. wire, 11d., ¼d. decrease.

Messrs. James & Shakespeare report. February 1st: Copper bars (best selected), sheet and rod, no change; English pig lead, no change.

Messrs. Johnson, Matthey & Co. report. February 1st: Platinum, £24 per oz.

Unemployment.—A slight decrease in the number of unemployed persons was shown in the last Ministry of Labour returns. The total on January 17th was 1,925,936, as compared with 1,934,789 a week earlier. The number employed upon special relief schemes was, on January 13th, 123,776.

The E.D.A. Salesmanship Conferences.—The fourth of the series of salesmanship conferences being organised by the British Electrical Development Association is to be held on February 17th, at 7.30 p.m. On this occasion Mr. Haydn Harrison will address the meeting on "Salesmanship in Relation to Electric Lighting."

Chinese Notes.—The Ministry of Communications is preparing to install a long-distance telephone between Peking and Harbin via Fengtien and Tientsin, which will be in operation next year.

A tramway company in Hankow is planned.

Hung Ao, of Shengchai Soochow (Kiangsu), has obtained registration of the Shengchai Fu Sin Electric Light Co., established with a capital of $15,000, from the Ministry of Agriculture and Commerce.

Electrical Exhibition.—At an Arts and Crafts Exhibition held in Motherwell recently, one of the most interesting and pleasing exhibits was the electrical section arranged by, and under the direction of, Mr. W. D. Brassington, the Burgh Electrical Engineer. The great variety and beauty of the various appliances was indicative of the skill and inventiveness that is being expended upon this branch of the trade, and was eloquent of the ever-expanding possibilities of electricity as applied to domestic affairs. The exhibits of Messrs. W. T. Henley's Telegraph Works Co., Callender's Cable & Construction Co., The Western Electric Co., General Electric Co., Edison & Swan Co., W. C. Yuille & Co., Simplex Conduits, Ltd., British Insulated & Helsby Cables, Ltd., The English Electric Co., and the Carron Co., were everything that could be desired, and included radiators, cookers, grills, boilers, hotplates, smoothing irons, kettles, toasters, dish washer, sewing machines, washing machine, vacuum cleaners, &c. A number of show cases representing the various systems of wiring also created considerable interest, as did a model water-tube boiler, lent by Babcock & Wilcox, and a fuel economiser by E. Green & Son, Wakefield. A model air filter, samples of turbine blading, a model engine and dynamo, and various other machinery parts in connection with the generating station were also exhibited, and proved very interesting. Working demonstrations of the various electrical appliances left no doubt as to their practical value as labour-saving devices and aids to the hygiene of the home. Two films on the electrical industry, entitled "The Economist" and "A Square Deal for his Wife," were also shown during the week. Mr. Brassington was able to report that a considerable amount of business had resulted from the exhibition. This fact suggests that such appliances only require to be shown in practical use to ensure their adoption wherever power is available.

The British Contract for South African Railway Electrification.—Pre-war suggestions for extensive conversion to electrical operation of the railway of the Union of South Africa have now crystallised into a definite programme, and a start is being made with the electrification of the Glencoe-Maritzburg section of the Natal line. In June, 1919, the consulting engineers (Messrs. Merz & McLellan) submitted a comprehensive report covering electrification schemes for:—

(1) Capetown to Touws River, and Capetown suburban lines.
(2) Glencoe-Durban and Glencoe-Vryheid East.
(3) Witbank-Germiston-Randfontein and Witbank-Komatipoort.

From this report it was apparent that the most pressing case was the Glencoe-Durban section, and particularly the 120 mile Glencoe-Maritzburg, as beyond Maritzburg conditions had been made easier by extensive deviations. The whole of the mineral traffic of the important Natal Coalfields for which Glencoe is a collecting centre passes over this line on its way to the coast at Durban, and for many years the mountainous stretches of country between Glencoe and Maritzburg had been a veritable bottle's neck, with the limit of steam traction possibilities reached. Important economies will be effected by the introduction of electric locomotives. Assuming a loaded traffic of 20,000 tons per day in one direction on a 1 per cent. up-grade, 11 electric trains, each of about 1,800 tons, will be capable of this duty, for which 14 steam trains would have to be employed. A most valuable feature of electrification in these hilly districts will be the characteristic of regenerative braking on descending grades, obviating all the wear and tear on wheels and brake shoes inevitable with steam traction. This electrification will be one of the most important hitherto undertaken, comparing in this respect with the Chicago, Milwaukee, and St. Paul undertaking, the locomotives being designed to take a direct-current supply of energy at a pressure of 3,000 volts on the trolley line. It is a matter for congratulation that the first order placed for this very important contract, amounting to between £750,000 and £1,000,000, has been secured by a British manufacturer, namely, the Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, in face of the most strenuous European and American competition. We refer to several gratifying aspects of the matter in our leader columns to-day.

L.C.C. Loan Interest Rate.—The *Times* states that the London County Council has reduced the rate of interest for local loans from 6½ to 6 per cent.

Trade Conditions in South Africa.—The latest statement by the general managers of the Standard Bank of South Africa regarding trade conditions in South Africa was to the effect that electrical material was arriving freely and stocks were ample, but demand was poor and prices were unchanged.

Long Service at Silvertown.—On January 24th, at the works of the India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd., at Silvertown, a presentation on behalf of a number of the staff and employés was made to Mr. H. C. Hammond, foreman of the fashioning shop of the gutta-percha department, to commemorate his completion of 50 years' service with the company. The gathering was presided over by Mr. Stuart A. Russell, works manager and director, the presentation being made by Mr. C. H. Gray, managing director. In presenting the testimonial, which consisted of a substantial wallet of Treasury Notes, coupled with a gold wrist watch for Mrs. Hammond, Mr. Gray spoke very highly of the recipient, whom, he said, he had always known as a hard worker and one of the very best of foremen. Mr. Hammond responded in suitable terms. As an example of the many long-service records at Silvertown, it may be mentioned that at the gathering there were present from the same department as Mr. Hammond six employés whose combined length of service reaches an aggregate of 270 years.

Railway Electrification and Unemployment Relief.—Mr. Arthur Neal, M.P., Parliamentary Secretary to the Ministry of Transport, speaking at Sheffield on January 28th, said he was hopeful that within a short time, by friendly negotiations now passing between the Ministry of Transport and some of the powerful railway companies in the South of England, a scheme of electrification would be started which would provide work for a number of the unemployed. In a subsequent interview Mr. Neal said he referred to three great Southern railways. He had at their request appointed a chairman, Sir Philip Nash, to preside over a small committee which was inquiring into the question. "The formalities may take some time," added Mr. Neal, "but I have no hesitation in saying that some success will be the outcome."—*Morning Post*.

The committee over which Sir Philip Nash (Director-General of Traffic) will preside will consider the possibility of a standard scheme for the electrification of certain sections of the Southern group of railways. The lines concerned are the London and South-Western, the London, Brighton and South Coast, and the South-Eastern. The Ministry has informed *The Times* that the new committee will be of a purely private character; its business will be the adjustment, if possible, of difficulties that have arisen out of the various proposals put forward by the above companies when the Ministry invited suggestions. Each company wants a different system adopted. The Committee is quite distinct from the departmental one that was appointed last year to advise the Minister on railway electrification generally.

For Sale.—Grimsby Corporation electricity department invites offers for two direct-coupled reciprocating steam sets.

Assets Auctions Co., Ltd., will sell by auction, at 119-121, Newington Causeway, S.E., on February 8th, electrical fittings, motors, fans, telephones, electric lamps, &c.

Central Electric Supply Co. invites offers. Two 1,050-kW Oerlikon turbo-alternators and two condensing plants.

Leek U.D.C. Electricity Department has for disposal two 100-b.h.p. Andrews horizontal gas engines, direct coupled to two 50-kW d.c. dynamos. (For full particulars see our advertisement pages.)

Ferranti Recreation Club.—The newly-formed Musical Section of the Ferranti Recreation Club gave three performances of the Gilbert & Sullivan opera, "Trial by Jury," in the Works Canteen on Wednesday, Thursday, and Monday, January 18th, 19th, and 23rd, preceded by a miscellaneous concert. We understand that the principals executed their parts in a brilliant manner. Mr. Moss (toolmakers) took the part of the Judge; Miss H. Quarmby (secretarial staff) was a most bewitching Plaintiff, and Mr. A. F. Perrin (costs), who was a member of the late Beecham Opera Company, was the Defendant. Mr. W. Winnard (toolmakers) played the part of Advocate, and Mr. Ogden (toolmakers) was the Usher. The performances proved a great success both musically and financially.

Engineers and Overtime.—The general secretary of the Amalgamated Engineering Union, Mr. A. H. Smethurst, states that the result of ballot voting in connection with the proposed agreement *re* management and overtime, which was the outcome of a conference between the Engineering and the National Employers' Federations and the Amalgamated Engineering Union in November last, is as follows:—In favour of accepting the proposed memo., 35,525; against accepting the proposed memo., 50,240. The men were asked to agree that the employers had the right to decide when overtime was necessary, and that the war-time restrictions imposed by the unions should be removed. Sir Allan Smith said at the time that the question at issue was whether the management was entitled to manage its own concern. The executive of the union recommended the adoption of the agreement.—*Daily Telegraph.*

Social Events.—The staffs of the Anchor Cable Co. and the St. Helens Cable Co. met on 27th inst. in an eight-a-side game of "ping pong." The result was a victory for the C.T.S. team by 17 events to 7 and 382 points to 333. This annual event has never been won by the St. Helens Co. before, although matches have been played for several years.

An informal dinner and reunion of past employés of Mr. R. W. Paul, late of New Southgate, was held on Saturday, January 28th, at the Great Eastern Hotel, London. Mr. Paul presided, and the evening was an unqualified success. Any past employés who were not notified on this occasion are asked to send their names and addresses to Mr. F. Stroude, 20, Lea Bridge Road, Clapton, London, E.5.

The Johannesburg Strike.—The conference between the employers and the miners of the Rand broke down on January 28th, the employers refusing to accept terms regarding the status of men employed in low-grade mines, the abolition of the contract system, and a reorganisation of underground work making no difference to the present working conditions until a final settlement was reached, put forward by the men's Federation. Up to the moment of going to press the threatened general strike had still failed to materialise, and it was reported that the position regarding coal supplies was easier, and it was hoped that the normal tramway and electrical services would be resumed on February 1st. The determined attitude taken up by both sides was stated to preclude the idea of intevention by the Government, which was, however, prepared for any eventuality. On January 29th it was reported that "commandos" of the strikers were active, warning officials carrying on essential services that they were "blacklegging."

A *Reuter* message dated January 31st indicated that numbers of men were returning to the coalfields, but that owing to the reduced demand it was improbable that work would be found for all of them.

Chloride Works Committee.—We have received a copy of the fourth annual report of the Works Committee of the Chloride Electrical Storage Co., Ltd., of Clifton Junction, near Manchester. It contains illustrations of the Chloride Roll of Honour and the memorial tablet. The report refers to the operations at the canteen and the men's dining room, the annual picnic, the employés' benefit fund, to which the company voted £5,000 for making grants in necessitous cases, the Recreation Club, and many other matters. The following paragraph relates to trade slackness and short time:—"The coal dispute, as well as the general trade depression throughout the country, has led to a certain amount of short time being worked, and even to some temporary reduction of numbers. The committee desires to thank the management for having, as far as possible, arranged matters so that the loss of time should be borne by all employés alike and should not press more hardly on one section than on another. The committee is always interested in information as to the condition of the company's trade when the management is able to keep it informed on this subject." The report is followed by a brief review of the doings of the Works Sick Club and a balance-sheet for the year.

Italian Industries.—The industrial situation in Italy is described in Italian official circles as being generally good, especially when the condition of industry throughout the world is taken into consideration. The metallurgical industry is to a great extent at a standstill, but there are signs of a revival. Engineering has also suffered from the abnormal conditions which prevailed after the war; nevertheless, many works have maintained their full-time activity. The competition from the countries of Central Europe, with the advantage of their excessively depreciated exchanges, constitutes the most serious obstacle which Italian industry has to overcome, but this competition is now less conspicuous, as such countries are likely to be engaged for several months in the execution of orders already received.—*Times.*

Strike at Cape Town.—The whole of the electricians employed by contractors in Cape Town and suburbs have been on strike since the New Year. The rate of pay during the latter half of last year was 3s. 4d. per hour, and the employers gave notice of a reduction to 2s. 6d. The workmen asked for 3s. 2d., and, as neither party would give way, a strike was the result. The employers have met the men and offered to compromise at 2s. 10d. until March 31st, but at the time of the mail leaving the men had refused to accept this offer.

German Grip on Swiss Industry.—Under this title the *Times* correspondent at Geneva reports that the independence of industrial Switzerland is threatened by a new danger. "Although Switzerland had, since the fall of foreign exchanges, bought in numerous shares which were held abroad, Swiss industry is now becoming more and more absorbed by the 'Holding' financial syndicates. These trusts have their origin in Germany, where they have apparently been established with a nominal seat abroad to deprive the Treasury of important taxes. The exportation crisis in Switzerland favours their absorption by the 'Holding' syndicates, on account of the advantages of transferring production outside Swiss frontiers. The firm of Sulzer & Co., of Winterthur, has just entered one of these concerns thereby losing their independence, and others in German Switzerland are on the verge of doing so."

Trolley 'Bus Contracts.—Messrs. Clough, Smith & Co., Ltd., of London, have secured from the Bloemfontein Municipality an order for five trolley 'buses of the "Straker-Clough" standard design; also from the Tees-side Railless Traction Board for a further four trolley 'buses.

The "Straker-Clough" trolley 'bus chassis has been adopted by the Rotherham Corporation, and an order has been placed with Messrs. Clough, Smith, who are the sole agents for this vehicle.

Callender's Works Fund.—We have before us a copy of the nineteenth annual report and accounts of Callender's Hospital and Distress Fund. As the coal crisis and other factors caused much unemployment the number of members decreased. Owing to the subscription being increased to 2d. per week in 1920 the Fund was able slightly to increase the total amount awarded to the hospitals. The report records the number of hospital, nursing home, and convalescent home letters granted, the surgical appliances and spectacles provided, and the financial assistance given. The weekly subscriptions realised £746, the company gave £50, and Sir Tom Callender £5 5s., and a number of directors and others several guineas apiece. The amount given to hospitals was £661, against £640. The report was adopted at a general meeting held on January 28th at the Belvedere Works, Sir Tom Callender presiding.

The Effect of High Taxation on Industry.—Sir Robert Horne, the Chancellor of the Exchequer, has informed the Federation of British Industries that he is prepared to meet its representatives on February 15th next, at 3.15 p.m., at the Treasury. This meeting was asked for in a letter addressed to the Chancellor of the Exchequer by Colonel O. C. Armstrong, the President of the F.B.I., which appeared in the Electrical Review for December 30th, p. 904.

At the first interview the Federation will urge in the strongest possible terms for an immediate reduction in the burden of taxation. It suggests that this could be done by a reduction in the rate of income-tax, the abolition of the Corporation Profits Tax, and the exemption from super-tax of reserves properly employed in the business of private firms. The Federation will also ask the Chancellor to grant it a further interview at a later date to discuss some very important outstanding points such as reclaims for excess profits duty paid by concerns which have undergone a change in ownership; the question of a three years' average system for income-tax, &c.

Industrial Labour-Saving Exhibition.—The General Electric Co., Ltd., is organising at its Industrial Showroom, Magnet House, Kingsway, W.C.2, during the week commencing Monday, February 6th, an exhibition of industrial electrical labour-saving appliances. The exhibits will include electric drills, grinders, polishers, &c., and the exhibition will be open from 2.30 to 6 p.m. daily.

German Aluminium Industry.—Dr. Steiner Reiner, in the course of a lecture delivered recently at Berlin, is reported to have expressed the opinion that after the exhaustion of the stocks of raw materials accumulated during the war, it will be impossible to maintain the German aluminium industry, which could only possess an artificial life.

Water-power Development in Newfoundland.—The Newfoundland Government is negotiating with Messrs. Armstrong, Whitworth and the Reid Newfoundland Railway Co. with regard to the project for a water-power development totalling 235,000 h.p. on the West Coast of Newfoundland. This would be utilised for the establishment of a paper mill with a capacity of 400 tons of newsprint daily, a factory for smelting aluminium with a capacity of 15,000 tons yearly, and other industries. The associated companies have asked the Government to guarantee the interest on £4,000,000 at 6 per cent., with a sinking fund of 1 per cent. for 37 years. If the companies and the Government reach an agreement a session of the Legislature to deal with the matter may be called before the end of this month.—*Reuter's Trade Service* (St. John's, Newfoundland).

The E.D.A.—Change of Address.—We are informed by the Electrical Development Association that it has moved its headquarters from Kingsway to 15, Savoy Street, Strand, W.C.2, the east entrance of the I.E.E. building. The new telephone number is "Regent 4570"; telegraphic address, "Electreda, Rand, London."

Electric Vehicles on Trial.—Two electric vehicle firms, Messrs. Richard Garrett & Sons, Ltd., and Messrs. Newton Bros., Ltd., have each offered to the Bedford Corporation an electric refuse-collecting wagon for a month's trial. The Council has decided to experiment with the vehicles.

Big Italian Works.—The Inter-Ministerial Committee, which was established by the Italian law of August 2nd, 1921, has now examined an application made for a State loan of 160,000,000 lire by a company interested in the construction of the proposed Sila and Simeto electricity works. The final arrangements for the loan are now in progress.

Siemens in Switzerland.—The German Siemens interests have converted their Swiss branch into an independent joint stock company under the title of the Siemens Electricity Products Co., with headquarters at Zurich, the share capital being 1,500,000 fr. Both Swiss and Germans are on the board of directors.

Big Electrification Scheme for Russia.—*Reuter* furnishes a copy of a lengthy telegram which the Russian Trade Delegation received under date January 23rd from Moscow. An interview is reported, in the course of which M. Bogdanov, chairman of the Supreme Economic Council, stated that foreign capital was indispensable in Russian industrial reconstruction, particularly under the new economic policy, which has revealed a lack of capital for organising big industrial enterprises. Russian industry can never hope to regain pre-war standards without foreign capital helping to replace equipment worn out during the last seven years in most enterprises. . . . Foreign capital is required for purchasing indispensable foreign materials, tools, equipment, &c., and regenerating the fundamental industries—viz., coal mining, petroleum, metallurgy, textiles, transport, &c. M. Bogdanov outlined several methods for attracting foreign capital:—

1. Credits opened by foreign banks, or a consortium to pay Russian orders abroad;
2. The floating of foreign loans through the State Bank;
3. Concessions;
4. The attracting of foreign capitalists as shareholders in various industries.

"The engineer Krezhezanovsky, chairman of the State Economic Planning Commission, emphasised that foreign capital was indispensable for electrifying Russian industries. He urges electrification as the most important factor in intensifying industry, which will have to be considered by the forthcoming International Conference on the economic restoration of Eastern Europe. Even in Russia electrification will necessitate foreign capital, as is demonstrated by the huge electrical imports even before the war. The electrification plan adopted by the Ninth Congress provides for a fifteen years' period, harmonising with the general industrial developments, and will play an enormous part also in regenerating agriculture, which should particularly interest West-European capital, since Russia represents the largest market for manufactures, and is the source of raw materials. Rural electrification, so advanced abroad, is only beginning in Russia, and the peasantry throughout the country display the liveliest interest. Electricity can be applied in all ameliorative plans, in sowing and harvesting, &c. The electrification plan provides for numerous electrical stations throughout the country, with the reorganisation and re-equipment of those already existing. These and other electrification works present an unlimited field of profitable investment for foreign capital. M. Krezhezanovsky pointed out that these plans are realisable through the establishment of a special bank on the principle of joint participation by all countries interested in Russia. Foreign capitalists have sufficiently weighty reasons for founding such a bank. The Russian base of raw materials is shifting gradually eastwards. Only by establishing a special Electrification Bank will it be possible to utilise to the utmost all Russian raw material resources. 'We now contemplate,' said M. Krezhezanovsky, 'electrifying the entire transport system from Moscow *via* Minussinsk and Altai to the mining region of Kuznetsky. This requires roughly 380 million gold roubles. If this great electrical route be connected with Berlin, there opens to Western Europe a vast opportunity for securing Siberian and Mongolian raw materials for European industries. Such prospects make indispensable only quite insignificant preliminary outlays.' Concluding, M. Krezhezanovsky emphasised that the electrification plan naturally arises from the general reconstruction plan, and is subject to improvement in accordance with the progress of national economic reconstruction."

Wages in Sweden.—*Folkets Dagblad* says that the electric company, Aktiebolaget Luth & Rosen, intends to reduce the wages of its employés by 22 per cent. on and from January 31st. The reduced wages will be still further cut down by 22 per cent. on March 28th.—*Reuter's Trade Service* (Stockholm).

Deed of Assignment.—W. MORRIS, electrical engineer, Cinema Buildings, Bridgend.—Claims by February 7th, to the Trustee, Mr. W. A. J. Osborn, 119, Finsbury Pavement, E.C.

New Spanish Company.—A new company has been formed, under the style of Gas de Cataluna, with a capital of 15,000,000 pesetas in shares and 35,000,000 in bonds, to acquire and work the Fabricas de Gas Lebon and the Fabricas de la Cataluna de Gas y Electricidad, the purchase price of the latter concerns being 6,000,000 in cash and 14,000,000 in bonds.

The Price of Meters in Austria.—The Austrian electric meter manufacturers have decided to raise the price of meters to inland consumers 7,900 per cent., the increase to date from January 10th.

L.C.C. Lamp Contracts.—The Stores and Contracts Committee of the L.C.C. reports that it has decided to restrict, for the time being, the invitation of tenders for the supply of electric lamps to British firms.

Australian Trade Conditions.—The Metal Trades Employers' Association of New South Wales is unhesitatingly blaming the high basic wage and the 44-hours' week for the prevailing unemployment in its trades. The Association has stated that the prospects for the machinery manufacturers are very black, as no manufacturers will turn out stock under present conditions. The machine tool industry, it is contended, has been hard hit, and an American firm which sent agents to Sydney to prosecute inquiries has declared that it can capture the Australian trade in this line again. It is feared that some well-known metal works at Newcastle will have to close down in February, being unable to compete with imported goods. If the stoppage takes place, four hundred men will be thrown out of work.—*Reuter's Trade Service* (Melbourne).

LIGHTING AND POWER NOTES.

Ammanford.—ELECTRICITY SUPPLY.—The Electricity Commissioners have granted a special order to the Urban District Council for the supply of electricity to the district.

Australia.—NEW SOUTH WALES.—H.M. Trade Commissioner at Sydney has issued a report on the proposed transmission line from Port Kembla power station to Bowral, Mittagong and Moss Vale. The line will be 22¼ miles in length, and will convey surplus energy up to 1,000 kW from the 2,000-kW power station at Port Kembla. The estimated cost is £32,000.

Blackburn.—ELECTRICITY SUPPLY.—The Electricity Commissioners have granted an order to the Urban District Council for the supply of electricity to Rishton, situated outside the area of supply under the Electric Lighting Order of 1890.

Bolton.—APPLICATION FOR LOAN.—The Electricity Committee recommends application to the Electricity Commissioners for sanction to borrow £31,200 to cover the cost of a new rotary converter for the Spa Road sub-station, for additional switchgear at Spa Road and Bradshawgate sub-stations, and for duplicate feeders from Back-o'-th'-Bank to the Bradshawgate sub-station.

Brackley.—ELECTRICITY SCHEME ABANDONED.—Owing to lack of support from the residents the Town Council has decided to take no further action in connection with the scheme for supplying electricity to the town.

Brentwood.—ELECTRICITY SUPPLY.—A meeting of the Brentwood Urban District Council and the Billericay Rural District Council was recently held to consider the question of electricity supply to Brentwood. It was pointed out that a Council scheme would cost about £30,000, and that there would probably be a large deficit during the first few years, which would have to be made up from the local rates. It was, therefore, decided to send a deputation to wait upon the Electricity Commissioners for their advice before seeking power to carry out the scheme.

Cardiff.—EXTENSIONS.—The Electricity Committee has under consideration a proposal put forward by the city electrical engineer for the installation of three water-tube boilers at an estimated cost of £29,500. The preliminary estimate of the cost of the extensions, including building work, is £59,300.

Chester.—ELECTRICITY SUPPLY.—Application has been made to the Electricity Commissioners for a Special Order to supply electricity within the Urban District of Hoole and parts of the Rural District of Chester.

Continental.—BELGIUM.—The Provincial Council of East Flanders has prepared plans for the distribution of electricity throughout the province. Existing stations and networks will be embodied in the general scheme, the Province advancing the funds to the communes and companies, the interest being paid from the receipts from subscribers. The scheme is estimated to cost about 9,000,000 fr.; and the Permanent Deputation has been authorised to arrange a first loan of 5,000,000 fr.

La Société d'Eclairage du Bassin Houllier de Mons has lately secured a concession for the supply of the electricity required in the town of Renaix during a period of 35 years. The electricity will be supplied from the generating station of the Société d'Electricitè de l'Ouest de la Belgique.

Dundee.—OPPOSITION TO GRAMPIAN SCHEME.—The price quoted by the Grampian Electricity Co. for a bulk supply of energy to the Corporation is considered too high, and although the latter is not against the development of the water-power resources of North Perthshire for electricity production, it has decided to petition against the order promoted by the syndicate. The Electricity Commissioners

have indicated to a Corporation deputation that the city's applications for extra borrowing powers to complete necessary extensions of steam plant would be in no way prejudiced by a failure to come to terms with the Grampian Co.

Dunmore.—ELECTRICITY SUPPLY.—A scheme is being prepared for the establishment of a public company to supply electricity to the town.

Edinburgh.—LOAN SANCTIONED.—The Electricity Commissioners have sanctioned the borrowing of a further sum of £516,314 for electricity undertakings in the city, particularly for the power station at Portobello, making the total amount authorised to be borrowed £1,632,514.

Egham and Staines.—EXTENSION OF AREA.—The Electricity Co. has applied to the Electricity Commissioners for a special order to extend its area of supply, to include the parishes of Ashford, Stanwell, Wraysbury, and Thorpe.

Halifax.—HIRE OF DOMESTIC APPLIANCES.—The Tramways and Electricity Committee has passed a resolution authorising the electrical engineer to purchase electrical apparatus, with a view to its being let out on hire and hire-purchase to consumers.

Hull.—FLOOD DAMAGE.—The damage to the plant at the power station, caused by the recent flood, has now been repaired at a cost of £2,600.

Kingston-on-Thames. — REDUCED CHARGES.—The Town Council is reducing the charges for electricity for lighting purposes from 1s. to 9d. per unit, and for power by 10 per cent.

London.—ST. PANCRAS.—The Borough Council reports a saving of £2,400 per annum by the introduction of automatic street lighting.

LOANS.—The L.C.C. Finance Committee, for various reasons, has reversed its decision to advance loans of £12,898 and £39,630 to the Metropolitan Borough Councils of Bermondsey and Bethnal Green respectively for electricity purposes.

Newark.—ELECTRICITY SUPPLY.—The Electricity Committee has been in negotiation with the Town Clerk of Lincoln and the Town Council of Lincoln has offered to supply Newark with electricity on the same terms as to Lincoln engineering firms. The scheme has been submitted to the Council's electrical engineer.

Peterborough.—EXTENSION OF AREA.—The Corporation is applying to the Electricity Commissioners for a special order authorising the extension of the area of supply to include the parishes of Longthorpe, Castor, Marholm, Walton, Eye Paston, Gunthorpe, Peterborough Without, &c., and to revise the maximum price.

Salford.—LOANS.—Application has been made to the Electricity Commissioners for sanction to borrow £36,000 for mains, services, &c., and £24,000 to cover the estimated expenditure on plant at the Frederick Road station in excess of the amount already sanctioned for that work.

Sidmouth.—ELECTRICITY SUPPLY.—The Urban District Council has adopted a scheme submitted by Mr. W. M. Harris, of Messrs. Gilbert Gilkes & Co., of Kendal, for the supply of electricity to the town. The initial cost of the scheme is estimated at £10,000, and includes the installation of a 100-h.p. gas engine and one of 50-h.p.

Sleights (near Whitby).—ELECTRICITY SUPPLY.—A meeting of ratepayers was held recently to consider the possibilities of a supply of electricity to the district and a sub-committee was appointed to make inquiries as to cost of plant, and to conduct a canvass of the district as to the probable demand.

Stockport.—YEAR'S WORKING.—The annual report on the electricity undertaking for the year ended March 31st, 1921, shows a total income of £132,341. Working expenses amounted to £120,186, leaving a gross profit of £12,155. After deduction of capital charges, &c., there was a net deficit for the year of £11,659.

Stone (Staffs).—ELECTRICITY SUPPLY.—A special meeting of the General Purposes Committee is to be held to consider the question of electricity supply.

TRAMWAY AND RAILWAY NOTES.

Australia.—VICTORIA.—A measure styled the "Melbourne, &c., Metropolitan Tramways Bill" has been agreed to by the Victorian House of Assembly. It authorises the Tramways Board to provide and operate electric railless trolley omnibuses in suburban districts where the population does not justify the laying down of rails. The estimated cost of a car to seat 28 passengers is £2,900.

Blackburn.—PARLIAMENTARY BILL.—In connection with the notice which appeared in our issue of January 20th, on a poll the ratepayers have rejected by a large majority the clause in the Parliamentary Bill giving the Corporation powers to extend the tramways and run an omnibus service, at an estimated cost of £268,000.

Burnley.—NEW TRACK.—The Burnley Corporation proposes to lay 2,000 yards of tramway track immediately consent is received from the Government authorities.

Continental.—CZECHO-SLOVAKIA.—The plans for the electrification of Czecho-Slovakia extend over a period of 20 years, at an aggregate expenditure of 3½ milliards kr. It is estimated that the saving in coal will amount to 120,000 wagon-loads per annum. First of all, the railway lines converging upon Prague are to be electrified within a radius of 30 miles in order to avoid the transport of coal to the capital.—*Reuter's Trade Service* (Prague).

GERMANY.—The prospect is now said to exist of the completion of the underground electric railway to connect the northern and southern districts of Berlin, which was commenced prior to the war, but the construction of which has been materially delayed owing to the lack of funds. The Berlin City Council, which is the party chiefly concerned in the construction of the railway, is now to consider a scheme for interesting private enterprise in the undertaking, which would take the form of the formation of a joint-municipal and private company. A combination of mortgage banks has agreed to provide 350,000,000 marks, secured on the railway property, while a further 150,000,000 marks is to be provided by an insurance company. If the scheme is carried out one portion of the railway is expected to be brought into operation this year and the remainder in October, 1923. The railway will be worked and the rolling stock provided by the existing Elevated and Underground Railway Co. in Berlin.

SWITZERLAND.—The entire length of the St. Gothard railway between Lucerne and Chiasso, comprising a length of 180 miles, will be electrified in the near future. The work of electrification has proceeded so far that the Lucerne-Arth-Goldau-Erstfeld section and the Bellinzona-Chiasso sections will soon be inaugurated. As to the conversion of other Swiss Federal railways, it is stated that the line from Lucerne to Zurich will probably be ready by the end of the present year, the line from Lucerne to Basle by the close of 1923, and that from Sitter to Lausanne in the same year. The National Council has decided to abstain for the present from the preparation of any further schemes of electrification of the remainder of the Federal railways.

Halifax.—TRACK RENEWAL.—The Tramways Committee has decided to renew the track between Nursery Lane and Illingworth.

POSTAL BOXES.—The Postal authorities have been approached with a view to installing letter boxes on the cars on various routes.

London.—TUBE BREAKDOWN.—The front coach of an Underground train left the rails in the tunnel between Holborn Station and Russell Square Station on Thursday last week, and the passengers had to alight and walk through the tunnel to the station. Upon investigation it was found that one of the axles had broken.

NEW L.C.C. CARS.—The L.C.C. tramcar services are being augmented by 125 new cars now in course of delivery. The new cars are being designed with a view to increasing speed and comfort, and are being equipped with 60 h.p. motors, as compared with the 44-h.p. motors used on existing cars. By means of white enamelled ceilings and a special arrangement of electric lighting the light is evenly distributed to all parts of the car.

METROPOLITAN DISTRICT RAILWAY.—The Minister of Transport has extended the time for the completion of the Wimbledon & Sutton Railway until July, 1923.

TRAMWAY PURCHASE.—The L.C.C. is purchasing from the London United Tramways, Ltd., the portion of the company's undertaking in Hammersmith, including the Chiswick power station, at a cost of £235,000, the purchase to be completed by May 2nd. The company will be at liberty to convert part of the generating station into a transformer station and to use this for a period not exceeding 21 years, providing the Council with electricity for the tramways up to 1,800,000 kWh per annum, free of cost, the Council paying for any excess at a rate to be determined by arbitration.

NEW CAR.—The London United Tramways, Ltd., has introduced, as an experiment, a one-man car. It is a single-decker, and is modelled on the American "safety car" lines.

Plymouth.—LIGHT RAILWAYS.—The Corporation is applying to the Minister of Transport for authority to construct and work light railways.

Portugal.—LISBON.—The tramway employés, who recently came out on strike, have now resumed work.

South Africa.—BLOEMFONTEIN.—The *Commercial Motor* recently described some railless electric cars being built for the municipality by Railless, Ltd., and Messrs. Short Bros., so far as the chassis is concerned, the body being built and mounted on the chassis by Messrs. C. H. Roe, Ltd., of Leeds. These are single-deck cars with clerestory roofs, arranged to seat 29. Two 20-h.p. ventilated motors provide the motive power through shafts to the rear wheels. The trolley poles are mounted on a base, patented by Railless, Ltd., which is carried at the head of pressed steel stanchions bolted to the chassis frame, so that no pole strain comes upon the roof.

Taunton.—DECISION AGAINST TRAMWAY PURCHASE.—Owing to financial considerations, the Corporation has decided not to purchase the Electric Traction Co.'s undertaking, and it is recommended that steps be taken to introduce a motor-bus service by private enterprise.

Tynemouth.—The Future of the Tramways.—At a recent meeting of the Town Council the Tramways Committee reported that it had met Mr. Stagg (local director) and Mr. W. Morrison (local manager), of the Tynemouth Traction Co. Mr. Stagg reported that it was estimated that the doubling of certain parts of the track would cost between £7,000 and £8,000, and the company could not undertake to spend the money unless arrangements were made with regard to tenure. The Council confirmed the Committee's suggestion that the company be informed that the Corporation was prepared to enter into an agreement consenting not to exercise its option to purchase the company's undertaking for a term of 21 years, subject, however, to satisfactory arrangements being made for the Corporation to exercise its rights at certain intervals on conditions to be agreed.

Uruguay.—Montevideo.—Owing to the continuance of the tramway strike the Municipal Council has taken over the company's undertaking, paying the men increased wages, and the services have been resumed.

TELEGRAPH AND TELEPHONE NOTES.

China.—Radio Stations.—The Chinese radio resolution of December 7th, at the Washington Conference, providing for the withdrawal of foreign wireless interests from China and the restriction of the use of domestically-controlled plant will stand as the Conference's only formal declaration on the subject under the decision of the Far Eastern Drafting Sub-Committee. This decision would appear to block the efforts of those desiring the above resolution rewritten, and it also blocks two new resolutions in this connection offered by Mr. Elihu Root.—*Reuter's Trade Service* (Washington).

India.—Bombay Telephones.—It is understood that arrangements are in progress for the sale of the Bombay Telephone Co. to an English corporation, and it is stated in this connection that the contract with the Government is being drafted afresh to permit a revision of the scale of charges to the public, says *Indian Engineering*.

London.—At the invitation of the Postmaster-General, a deputation from the London Chamber of Commerce is visiting telephone exchanges in the City to see for itself the method of registering calls and the meters used for the purpose. The examination is the outcome of complaints made by the Chamber.

Storm Damage.—Tangier.—As a result of a severe storm, direct cable communication with Tangier was interrupted early this week, says *The Times*.

South Africa.—Wireless Telegraphy.—The Marconi Co. has offered to equip South Africa with an efficient long-range wireless service, within 18 months, and to run the station when completed. The company undertakes that its expenditure on the proposed station shall not be less than £400,000, exclusive of duty and sites. Alternatively, the company offers to build and conduct stations on a joint account with the South African Government.—*Reuter's Trade Service* (Capetown).

The Telegraph Service.—The telegraph cables connecting the Western Isles, Inverness, with the mainland having been broken during recent storms, the P.M.G. is arranging for a temporary wireless service to be inaugurated.

Foreign Telegrams.—The volume of foreign telegraph traffic recently handled in the Central Telegraph Office has averaged 174,000 messages a week, says *The Times*, the bulk of which has been dealt with in the evening. Business firms are urged to hand in their telegrams as early as possible so that the traffic over the Continental lines may be distributed with some degree of evenness.

The Telephone Service.—Hull.—The municipal telephone undertaking shows a profit during the past year of £4,500 after the payment of £7,000 in rates and £10,000 in royalties to the Government. A new automatic exchange is to be opened this month, says the *Daily Mail*.

United States.—Wireless Telephony.—To ensure that reports of crimes may be transmitted instantly over the whole city, the chief of the Chicago police has decided to equip every policeman on duty with a miniature wireless telephone receiving set. The apparatus will be carried in the policeman's pocket, and the antennæ will be concealed in the lining of his coat. The constable's attention will be attracted by a buzzer, which forms part of the instrument. As a further aid to combating motor bandits light cars carrying a dozen armed policemen have also been ordered. These carry more powerful wireless telephones, which can both send and receive, similar to those that have been ordered for the French police.—*Daily Mail*.

Cable Ship Lost.—The Western Telegraph Co.'s cable steamer *Cormorant* has foundered off the coast of South America. The crew was taken off after nine hours' work in unsuccessful efforts to keep the water under, says the *Daily Dispatch*.

Wireless Telegraphy.—G.P.O. Concession for Amateurs.—The General Post Office authorities have agreed that, starting probably early in February, permission will be given for the sending out by wireless telegraphy on certain fixed wavelengths, of speeches and music, for half an hour on one day in every week, for the benefit of amateur wireless enthusiasts. It is understood that the Marconi Co. will undertake all necessary arrangements at its high-power station at Chelmsford. The hon. secretary of the Wireless Society of London (Mr. Leslie McMichael) told *The Times* that the society had been trying for about twelve months to secure this privilege for amateurs. The British Government was far behind those of the United States, France, and Germany in this direction. The Society was formed in 1913, and had now a membership of 380. There were between five and six thousand people in Great Britain with licences for receiving installations, and probably 150 held transmission licences in addition.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Accrington.—Corporation. One 6,000-kW turbo-alternator with condensing plant. (January 20th.)

25,000 lb. water-tube boilers, economisers, and brick work. —(See this issue.)

Ashton-under-Lyme.—February 22nd. Electricity Committee. Circulating water pipes and valves and exhaust steam pipe. (See this issue.)

Australia.—Melbourne.—April 29th. Victorian Electricity Commissioners.—31 miles .15 sq. in. 3-core power cable and 20 miles, .007 pilot cable, with accessories, for a 22,000-V circuit. —*Reuter's Trade Service* (Melbourne).

Adelaide.—April 5th. P.M.G.'s Dept. Twelve adjustable condensers for use on telegraph duplex circuits. (Sched. No. 613.)*

Brisbane.—April 19th. P.M.G.'s Dept. Testing and telegraph instruments. (Stores Sched. No. 549.)*

Aylesbury.—Electricity Department. One 1,500-kW or alternatively one 1,000-kW turbo-alternator, condenser, and switchgear. (See this issue.)

Bulgaria.—March 21st. Bulgarian Postal Authorities. Telephone pole-line hardware (four pin carriers for insulators, bolts, &c.).*

March 28th. 3,000 junction pieces for batteries, &c.*

Burton-on-Trent.—February 8th. Board of Guardians. Electric light installation, workhouse hospital. Mr. H. S. Askew, clerk.

February 22nd. Electricity Dept. One 6,000-kW turbo-alternator with condenser and switchgear. Two 40,000-lb. water-tube boilers complete with economisers, coal-handling plant, bunkers, buildings, and chimneys. (See this issue.)

Dundee.—February 10th. Tramway stores, including insulated wire, lamps, switches, &c. Mr. W. T. Young, manager, Town Hall Buildings, High Street, Dundee.

Edinburgh.—February 15th. Electricity Supply Department. Auxiliary circuits and electric lighting and earthing, for Westbank power station. (Spec. No. 34.) (January 27th.)

East Grinstead.—February 24th. U.D.C. Two-stroke oil engine-driven generators, motor balancer booster, steam engine and dynamo, storage batteries, switchboard, superheater, feed-water heater, &c., cable system, street lamps, travelling crane. (See this issue.)

Eston.—February 28th. Urban District Council. Overhead lines, underground cables, transformers, sub-station equipment, and public lighting fittings. (January 27th.)

France.—Paris.—February 20th. French Post and Telegraph Authorities. Rubber-insulated and lead-covered paper-insulated telephone cable. Direction de l'Exploitation Téléphonique, 102, Rue de Grenelle, Paris.

Glasgow.—February 6th. Electric lighting installation in connection with Moorpark housing scheme. R. B. Mitchell, electrical engineer, 75, Waterloo Place, Glasgow.

Gloucester.—February 14th. Electricity Department. Two 1,500-kW turbo-alternators with condensing plant. (See this issue.)

Leeds.—February 10th. Corporation. Supply of electrical fittings. W. T. Lancashire, city engineer, Municipal Buildings.

London.—February 13th. L.C.C. 2,500 or alternatively 4,500 tons of standard steel girder tramway track rails with fishplates. Chief Engineer, 19, Charing Cross Road, W.C.2.

Hammersmith.—February 22nd. Electricity Department. Stores for three, six, or twelve months, including electric light sundries, insulated wire, joint boxes and connections, meters, stoneware conduit, &c. (See this issue.)

Paddington.—February 20th. G.W.R. Three months' supply electrical and telegraph stores. (See this issue.)

Manchester.—February 10th. Electricity Committee. One 2,000-kW induction motor-generator with switchgear. (January 27th.)

February 14th. Tramways Committee. General stores, &c. J. M. McElroy, general manager, 55, Piccadilly, Manchester.

Portlaoighise.—February 8th. District Mental Hospital. Supply of 55 complete renewal sections for 33 plate, B.N. type, Sandycroft battery. (January 20th.)

South Africa.—Durban.—April 12th. Corporation Electricity Department. Two 500-kW rotary converter sub-station equipments or alternatively mercury arc rectifiers with automatic switchgear.*

Skipton. — February 25th. Electricity Department. Supply, laying, and jointing l.p. 4-core paper-insulated lead-covered steel-tape armoured cable. (See this issue.)

Wolverhampton. — Electrical Engineer's Department. Two water-tube boilers and integral superheaters. (See this issue.)

*A copy of the plan, specifications, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Brussels.—Post and Telegraph Department. Three home concerns submitted tenders for the supply of micro-telephonic battery posts, the lowest offer (436,500 fr.) being that of the Société Electricité et Mécanique, of Brussels.

Five concerns, including Henley's Telegraph Works Co., Ltd., submitted tenders recently to the Railway Department of the Belgian Ministry of War in Brussels for the supply of 600 metres of leather-covered two-conductor cable and 400 metres of electric wire, the lowest offer being that of the Société des Cables et Fils Electriques, of Brussels.

London.—L.C.C. Highways Committee. Accepted:—
2,000 trailing wheel tires, £3,600.—Steel, Peech & Tozer, Ltd.

Stores and Contracts Committee.—During the three months ended December 31st the following contracts have been placed:—

Electric lamps (Schedule No. 17).—Cryselco, Ltd. Items 10 to 13, estimated value £50.—English Electric & Siemens Supplies, Ltd. Items 1 to 9, estimated value, £7,250.
Iron castings for the Tramways Department.—Carron Company, Hadfields, Ltd., J. Needham & Sons, Ltd., T. Summerson & Son, Ltd.
Steel castings.—A. T. Green & Sons, Ltd.

Salford.—Electricity Committee. Accepted:—
2,000 yds. 3-core l.p. cable, £446.—W. T. Glover & Co., Ltd.
4,000 yds. concentric l.p. cable, £839.—Enfield Ediswan Cable Co., Ltd.

FORTHCOMING EVENTS.

Institution of Electrical Engineers.—Informal meeting. Monday, February 6th. At the Institution, Victoria Embankment, S.W. At 7 p.m. Discussion on "Some Practical Applications of the Thermionic Valve," to be opened by Mr. J. Joseph.

(Irish Centre, Dublin).—Friday, February 10th. At the Royal College of Science, Upper Merrion Street. At 8 p.m. Paper on "A Method of Regulating the Voltages on the Two Sides of a 3-wire C.C. System Equalised by Static Balancers," by Mr. R. D. Archibald.

(North-Eastern Centre).—Thursday, February 9th. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Conversazione.

(North-Western Centre).—Tuesday, February 7th. At the Engineers' Club, Manchester. At 7 p.m. Paper on "Interconnection of A.C. Power Stations," by Messrs. L. J. Romero and J. B. Palmer.

(Western Centre).—Monday, February 6th. At the South Wales Institute of Engineers, Cardiff. At 4.45 p.m. Visit of the President (Mr. J. S. Highfield). Annual dinner.

(South Midland Centre, Students' Section).—Tuesday, February 7th. At the University, Birmingham. At 7.30 p.m. Paper on "Telephone Transmission Through Submarine Cables," by Mr. A. Rosen.

(Liverpool Students' Sub-Centre).—Thursday, February 9th. At the University, Liverpool. At 7.30 p.m. Lecture on "Wireless Telegraphy and Telephony," by Prof. E. W. Marchant.

Institution of Civil Engineers.—Tuesday, February 7th. At the Institution, Great George Street, S.W. At 6 p.m. Paper on "Hydro-electric Installations of the Barcelona Traction, Light & Power Co.," by Dr. H. F. Parshall.

Students' Meeting.—Thursday, February 9th. At the Institution, Great George Street, S.W. At 6 p.m. Paper on "The Design of Modern Water-turbines," by Mr. E. J. Kingston-McCloughry.

Roentgen Society.—Tuesday, February 7th. At the Institution of Electrical Engineers, Victoria Embankment, S.W. At 8.15 p.m. Ordinary meeting.

Association of Engineers-in-Charge.—Wednesday, February 8th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. "Some Practical Notes and Observations on Land Type Boilers," by Capt. H. J. Wellingham.

Industrial League and Council.—Wednesday, February 8th. At 7.30 p.m. At Caxton Hall, Westminster. Lecture on "Industrial Unrest: Does it Make for Progress?" by Prof. A. W. Kirkaldy.

Institute of Cost and Works Accountants.—Wednesday, February 8th. At the Institute of Patent Agents, Staple Inn Buildings, W.C. At 7 p.m. Lecture on "Hollerith Systems and Machines.—Some Applications," by Mr. G. A. Everard Green.

Institution of Post Office Electrical Engineers (London Centre).—Wednesday, February 8th. At the Institution of Electrical Engineers, Victoria Embankment, S.W. At 5.30 p.m. Exhibition of kinematograph films, entitled: "Thermionic Valves and their Application" and "Telephone Inventors of To-day."

Optical Society.—Thursday, February 9th. At the Imperial College of Science, South Kensington, S.W. At 7.30 p.m. Annual general meeting.

Chelmsford Engineering Society.—Thursday, February 9th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Air Compressors," by Mr. H. A. Hartley.

Manchester Wireless Society.—Thursday, February 9th. At the Albion Hotel, Piccadilly, Manchester. At 8 p.m. Paper on "Motor Starters and Regulators," by Mr. A. G. Gregory.

Chemical Society.—Thursday, February 9th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 8 p.m. Lecture by Sir Ernest Rutherford, F.R.S.

Electro-Harmonic Society.—Friday, February 10th. At the Great Hall, Cannon Street Hotel, E.C. At 8 p.m. Concert (ladies' night).

King's College Engineering Society.—Friday, February 10th. At the Institution of Civil Engineers, Great George Street, S.W. At 5.30 p.m. Anniversary meeting. Paper on "Water Engineering," by Mr. F. W. Macaulay.

Junior Institution of Engineers.—Friday, February 10th. At Caxton Hall, S.W. At 8 p.m. Questions and general discussion.

Edinburgh Electrical Society.—Friday, February 10th. At the Philosophical Institute. At 8 p.m. Apprentices' night. Short papers on "Plant or Installation Work" for the Society's prize.

Physical Society of London.—Friday, February 10th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Annual general meeting.

Birmingham and District Electric Club.—Saturday, February 11th. At the Grand Hotel. At 7 p.m. Paper on "Illumination from the Users' Point of View," by Mr. C. G. A. MacDonald.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

We continue to receive many inquiries without the necessary stamped addressed envelope for reply. We would, therefore, once again remind inquirers of the simple rules of the Service Department:—

1. Address your inquiries to the Electrical Review, Ltd., Service Department, *and enclose a stamped addressed envelope.*

2. Do not ask for information until you have satisfied yourself that it is not already contained in our advertisement pages.

3. If we are the means of putting you in touch with the firm or firms that you require, do us the favour of mentioning the Electrical Review.

No charge is made for the service.

To complete our answers this week we need the names of suppliers or manufacturers of:—
A collapsible hall lantern finished in polished brass, and bearing marks: "British Make Prov. pat. /23073.
A heat-resisting lacquer for brass which will really withstand considerable heat.
Unimote 2-kW electric lighting plant.
Helia wood pear switch (Belgian).
We also require the address of:—
The Tonelyte Manufacturing Co.

NOTES.

Electrical Contractors' Concert and Conference in London.—The London Committee of the Electrical Contractors' Association (Inc.), has decided to hold a smoking concert at the Engineers' Club on Tuesday, February 14th, at 8 p.m., in order that the members in London may have an opportunity of meeting the president, who resides at Leicester, and other members of the Council from the Provinces. In addition to the ordinary concert there will be discussion of matters relating to the electrical industry as a whole, together with special reference to the work of the Contractors' Associations, and any London electrical contractor wishing for information regarding the work of the Associations is heartily invited to attend the meeting. Should any such contractor wish to do so he should notify Mr. Leonard G. Tate, the general secretary, at 11, Southampton Row, London, W.C.1, who will forward a ticket.

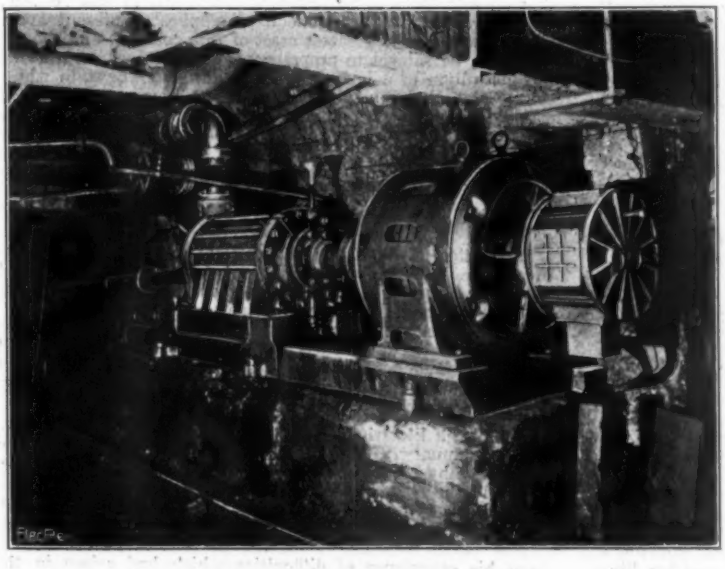
National Association of Supervising Electricians.—Annual Dinner. — On Saturday last the annual dinner of the N.A.S.E. was held at the Restaurant Frascati, London, the President, Major T. Vincent Smith, M.C., M.I.E.E., being in the chair; the members and guests present numbered about 150. In proposing the toast of "The King," the Chairman referred to His Majesty's becoming Patron of the I.E.E. last year. The health of "The President" was proposed by Mr. F. W. Smith, who expressed the indebtedness of the Association to Mr. J. S. Highfield, President I.E.E., the immediate past president, and paid a tribute to the tact and ability of Major Smith, a pioneer of wireless telegraphy on aeroplanes. A message from the ether in the Morse code then arrived by "buzzer," and proved to be the familiar refrain with which the gathering accorded musical honours to the subject of the toast. In responding, Major Smith expressed his sincere appreciation of the honour of being the president of that magnificent Association, which devoted itself to the acquisition of knowledge, and was co-operating with the parent Institution in the work of its Committees.

Major Hogan, proposing "The Association" in an amusing speech, said that every branch of the electrical industry had its own pet association except the commercial side; he favoured the idea of one big association for the lot. The N.A.S.E. had made steady progress since its formation in 1914, and gave the most careful attention to the educational side of its activities, affording special facilities and low rates of subscription to the associates. Mr. C. G. Wright responded, remarking that the Association had passed through very troubled waters, but had now got over its difficulties, and had a general secretary to look after its interests, who would be able to present a very favourable report at the annual meet-

ing. The Association hoped shortly to extend its operations to the provinces, and had made a good start at Manchester and Ipswich. It had been particularly well received by the industry in general, and hoped to enrol every foreman engaged in it. In order to improve the educational facilities, every employer ought to become an honorary member. Great care was taken with regard to membership; every member was a fully qualified man.

Mr. J. S. Highfield proposed "The Visitors," congratulating Mr. Banister and other founders on the success of their labours in establishing the Association, which was a solid body of honourable men, every one of whom was imbued with the spirit of service and efficiency. He did not agree that the several Associations should combine in one gigantic body. The technical Press had served the electrical industry extraordinarily well, and the Electrical Development Association was performing a great service, though with limited funds; it was established on a firm foundation, and its influence would continue to grow. Sir R. Burton Chadwick, M.P., responded in a humorous speech, and expressed regret at the scarcity of men acquainted with science and engineering in Parliament; he felt that it was dangerous for Members to interfere with an industry which they did not understand. The electrical industry meant more than any other to the development and well-being of the country. Mr. T. H. Windibank proposed "The Press" in complimentary terms, congratulating the Association and the industry on the possession of a free and independent trade Press, and Mr. A. H. Allen responded. An excellent programme of music, organised by Mr. Geo. Robinson, was interspersed with the toasts, and the function was exceptionally successful and enjoyable, the arrangements reflecting great credit on the organisers. The President took occasion specially to congratulate the secretary, Mr. Brammer, and those who had assisted him in organising the entertainment.

A Motor in a Fiery Mine.—The accompanying illustration shows a 100-h.p. "Witton" motor, with a flame-proof slip-ring cover, installed in a fiery mine—Taylor's Navigation Colliery, Nantgarw. The machine, which runs at 2,000 V, 50 cycles, 1,500 r.p.m., is employed in driving a centrifugal pump. The General Electric Co., Ltd., informs us that the photograph was taken by the light of a single 500-W "Osram" gasfilled lamp; the result is certainly excellent.



A "Witton" Motor in a Fiery Mine.

Educational.—East London College, University of London, Mile End, E.1.—A course of eight lectures on the thermionic valve and the arc as generators for radio-telegraphy will be given on Tuesday evenings during February and March at 6 p.m. by Professor W. H. Eccles, F.R.S., and Mr. C. F. Elwell. Professor W. H. Eccles will deal with the subject: "The Three-Electrode Thermionic Valve as a Generator of Electrical Oscillations" on February 7th, 14th, 21st, 28th, and March 7th. Mr. C. F. Elwell will give three lectures on "The Poulsen Arc Converter" on March 14th, 21st and 28th. Fee for the course, two guineas; students attending university courses at colleges and institutions of the University, 10s. 6d. (For further particulars see our advertisement pages to-day.)

Service Notes.—Warrant-Electrician F. Sweetman has been posted to the destroyer *Diligence*, in the Mediterranean. The following officers of the Kent Fortress Engineers have resigned their commissions: Capt. E. Lefeaux, A.M.I.E.E.; Lieut. A. P. Isard, A.M.I.E.E.; Lieut. A.M'L. Atkinson, A.M.I.E.E.; and Lieut. J. C. de Wardt, A.M.I.E.E. The latter three officers have been given the rank of captain on leaving the regiment. It is believed that further cuts will be made in the establishments of the electrical departments of both services on the score of economy.

Fatality.—A verdict of "accidental death" was returned at a Bradford inquest, on January 27th, into the death of Lawrence Waterhouse (23), a tester employed at the Phœnix Works of the English Electric Co., Ltd., who was found dead recently, lying on a motor test bed at the foot of a switchboard in the motor erecting shop. Harold Sutcliffe, foreman, said deceased's head was on the iron frame of the board and the witness pulled the body away after insulating himself. The circuit breaker was in, and below it was a loose wire, coupled to a motor, apparently with a view to testing. Dr. Wrangham, testifying that death appeared to be from shock, said that in cases of apparent death through shock it was well to continue attempts at artificial respiration until a doctor arrived. Mr. L. Jessop, an engineer, said there appeared to have been a pressure of 500 volts. Waterhouse could not have saved himself any appreciable amount of time or trouble by neglecting to open the circuit breaker. The board was up-to-date and good and safe. Witness had tested the floor in front of the board and found it quite in order. The regulations of the Home Office appeared to have been observed fully by the firm. Jos. S. Aykroyd, a tester, said the circuit breaker was found to be in good order. The Coroner, addressing the jury, said that nothing in the evidence threw blame on anybody.

Workers' Welfare.—At a luncheon at the Connaught Rooms recently, Lord Invernairn (chairman and managing director of William Beardmore & Co.), the chairman of the Industrial Welfare Society, gave an informal address on the object and activities of this organisation, and initiated a discussion upon the improved relationship between master and man in firms where the Society's principles had been adopted.

Lord Invernairn said he was a great believer in the benefits to be obtained from the movement by both employers and workers in this country. The scheme was of immense importance, and would have the effect of bringing about a much better understanding between the so-called capitalist and the worker.

The Rev. Robert R. Hyde, the director of the Society, said that no one had ever attempted to estimate the enormous amount of time lost through minor ailments. It was one of the objects of the society to urge provision for the care of even the smallest accident in workshops, with a view to saving time. Legislation for safeguarding against machinery, &c., was largely wasted unless the worker himself could be induced to take an interest in his own safety. Employés were encouraged to give attention to their own welfare and their work and to make suggestions for improvements. The industrial welfare supervisor was an important member of the staff and acted as an ever free channel between master and worker. He would deal with all complaints, and it was found that prompt attention to these matters invariably resulted in trouble being nipped in the bud.

The welfare movement was constantly expanding, and last year representatives of the society discussed the subject with the heads of more than 3,000 firms. Inquiries were continually being received not only from different parts of Great Britain, but from all over the world.

Mr. Button, of the Amalgamated Engineers' Union, and a member of the Industrial Court, stated the attitude of labour to be one of great friendliness to the movement. Some people saw in it the promise of a new era as between workers and masters. There was already a new spirit permeating industry, and the Industrial Welfare Society might render unnecessary certain operations of the trade unions.—*Financial Times.*

North Lancs. & South Cumberland Electricity District.—Commissioners' Inquiry.—The local inquiry by the Electricity Commissioners in connection with the scheme for the constitution of a Joint Electricity Authority for the above-named area, that was submitted by the Provisional Joint Committee for the district, was opened at Barrow-in-Furness on January 31st. Sir J. Snell presided, and there was a large attendance. Mr. W. S. Kennedy, for the Joint Committee, outlined the scheme, and Mr. P. J. Hibbert, J.P., chairman of the Committee, supported it, and was closely examined by Mr. E. Woolf, for the Barrow Corporation. Mr. H. R. Burnett, secretary to the Committee and electrical engineer to the Barrow Corporation, submitted new tables showing the generation costs for 1921, at which stage the inquiry was adjourned until the following day. We hope to publish fuller details next week.

INSTITUTION NOTES.

The Institution of Electrical Engineers.—Commemoration Meetings.—The following is the programme for the meetings which are to be held on February 21st, 22nd, and 23rd in commemoration of the first meeting of "The Society of Telegraph Engineers," held on February 28th, 1872:—

TUESDAY, FEBRUARY 21st, 1922 (at 3 p.m.).—Experimental lecture by Professor J. A. Fleming, M.A., D.Sc., F.R.S., on "Michael Faraday and the Foundations of Electrical Engineering."

(Note.—The Annual Dinner of the Institution will be held this day at the Hotel Cecil, Strand, W.C., at 7 p.m. for 7.30 p.m.)

WEDNESDAY, FEBRUARY 22nd, 1922 (3.30 to 6 p.m.).—Short discourses on "Reminiscences and Experiences of Electrical Engineering in both its Technical and Legislative Aspects."

(At 8.30 p.m.).—Professor Fleming will repeat his lecture of the previous day.

THURSDAY, FEBRUARY 23rd, 1922 (3.30 to 6 p.m. and 8 to 10 p.m.).—Continuation of discourses on Electrical Engineering.

It is hoped that the contributors on the Wednesday evening (February 22nd) and on the afternoon and evening of Thursday (February 23rd) will include the following:—

Mr. Ll. B. Atkinson	Mr. J. E. Kingsbury
Mr. Frank Bailey	Sir Oliver Lodge, D.Sc., F.R.S.
Mr. O. H. Baldwin	Prof. M. Maclean
Mr. G. Balfour, M.P.	Mr. W. H. Massey
Sir T. O. Callender	Prof. T. Mather, F.R.S.
Mr. R. A. Chattock	Sir William Noble
Col. R. E. Crompton	Lord Parmoor
Mr. B. Drake	Sir C. A. Parsons, K.C.B., F.R.S.
Mr. H. Edmunds	Mr. G. W. Partridge
Sir K. Elphinstone, K.B.E.	Mr. W. H. Patchell
Mr. W. B. Esson	Mr. J. H. Rider
Mr. S. Evershed	Mr. F. H. Royce
Dr. S. Z. de Ferranti	Dr. A. Russell
Prof. G. Forbes	Mr. A. Siemens
Mr. E. Garcke	Mr. C. P. Sparks, C.B.E.
Prof. Andrew Gray, LL.D., F.R.S.	Mr. G. Sutton
Mr. F. E. Gripper	Mr. J. Swinburne, F.R.S.
Mr. H. Hirst	Mr. A. A. Campbell Swinton, F.R.S.
Mr. J. H. Holmes	Mr. J. C. Vaudrey
Mr. W. Judd	Mr. A. H. Walton
Dr. G. Kapp	Prof. E. Wilson
Sir J. Kemnal	Mr. C. H. Wordingham, C.B.E.
Sir Alexander Kennedy	Mr. A. Wright.
Dr. A. E. Kennelly	

A limited number of tickets will be available for visitors introduced by members. Early application for such tickets (not more than one per member) should be made to the secretary. The tickets will be posted as soon as possible after February 10th, and in the event of the applications being in excess of the number of tickets available, a Committee of Selection will allot the tickets. No tickets will be required for members.

South Midland Centre —*Students' Section*.—The following meetings have been arranged: February 7th, "Telephone Transmission through Submarine Cables," by A. Rosen, B.Sc.; March 7th, "The Measurement of Flux Density in the Air Path of a Magnetic Circuit," by W. P. Conley, B.Sc.; April 4th, "Control of the Live Rail on Electrified Railways," by F. T. Pamment; April 25th, annual general meeting.

Informal Meetings Section.—At the meeting on January 23rd, Mr. R. Grierson was in the chair when Mr. R. J. Mitchell opened a discussion on "Electric Vehicles." He said that in spite of the simplicity of control, the electric vehicle had not made the progress expected of it. In the past this was due largely to the low cost of fuel for the petrol vehicle, whilst the high first cost of the electric vehicle was to-day made to seem extravagant by the very low prices obtainable for second-hand lorries. Yet the electric vehicle was particularly suitable for internal town transport. It was easily adapted to special equipment, such as tipping gear, cranes, elevating apparatus, &c., which, with other vehicles, could only be obtained in a roundabout way. He read testimony to the merits of electric vehicles from the experience of many corporations and large commercial users, showing in some instances most remarkable savings in time and handling, and appealed for fuller co-operation in the matter of charging facilities from supply engineers. With regard to improvement in electric vehicles, the last word in battery design had not yet been said, and he thought the B.E.A.M.A. should offer a £100,000 prize for a battery giving, say, 40 watt-hours per lb. If a share in the royalties on this battery were stipulated for, there would be no need to set aside a reserve for the prize money. The chassis was not perfect either, it could be enormously improved and lightened by better materials. Further, he had found wheels that could with safety, even improvement, be pared down 2¼ cwt. per set.

Mr. A. W. Blake, of Willesden, gave a glowing testimony to the virtues of electric vehicles on municipal duties. He spoke from experience of many years, and at present was associated with eighteen electric, as well as several petrol vehicles. Every electric vehicle was working every day, and his figures of working hours showed an astonishingly good service, and freedom from even minor breakdowns.

Mr. N. Murphy continued the appeal for less apathy from supply engineers, and declared that if this vehicle was not taken seriously, the vehicle makers would perforce provide their own charging facilities.

Mr. A. G. Whyte recalled the statement that the cleansing superintendents had done more for the electric vehicle than all the station engineers.

Messrs. F. Jackson, W. E. Warrilow, A. F. Harmer, W. E. Rogers, E. W. Epton, W. J. Minton, W. R. Montgomery, G. Y. Fraser, E. G. Kennard, E. A. Scarborough, and R. Grierson also spoke.

The following programme of informal meetings for the month of February has been arranged:—

February 6th, "Some Practical Applications of the Thermionic Valve," Mr. J. Joseph; February 13th, "The Evolution of a Staff Trade Union," Mr. J. H. Parker; and February 20th, "On the Emergency Use of Oil Fuel during the recent Coal Strike," Mr. E. F. Hetherington.

A.M.I.E.E. Examination.—It is proposed, if a sufficient number of candidates make application, to hold the Associate Membership examination in London and at other places (at home and broad) in April, 1922. Entry forms and full particulars can be obtained from the Secretary of the Institution, Savoy Place, Victoria Embankment, London, W.C.2.

Junior Institution of Engineers.—On January 27th Mr. L. M. Jockel, of the North Metropolitan Electric Power Supply Co., delivered a lecture on "Fuels and the Boiler House." The first part of the lecture dealt very fully with the chemical analysis of coal, and Mr. Jockel described the constitution of various "standard" types, explaining the main differences between bituminous and anthracitic coals. A number of calorimeters were described, particular attention being drawn to the Thomson-Rosenhain apparatus, in which combustion is assisted by means of low-pressure oxygen. The speaker showed a form of bomb calorimeter which he himself used, and which, he explained, had the outstanding merit of cheapness. He stated that he had had occasion recently to inquire into the advantages of employing a technical engineer solely for the purpose of testing samples of coal, and had drawn the conclusion that even in a station purchasing no more than £120 worth of coal per week such an engineer would secure economies more than justifying his salary. It was complained that technical engineers were scarce, but Mr. Jockel thought the lack of response was due to the inadequacy of the salaries offered. Referring to the use of oil fuel in boiler furnaces, Mr. Jockel considered that, in spite of its many advantages, oil would not replace coal in this country as a steam-raising agent. In a comparison of costs he showed that oil had little or no advantage over coal in this respect; he also referred to the inadequate supplies at present available. Coal was the greatest asset of this country, and should, therefore, be subject to proper control. Mr. Jockel advocated the institution of a body which should definitely state which classes of coal should be used for direct burning, and which classes should be reserved for distillation and scientific treatment. The speaker then laid stress upon the need for intelligent supervision in boiler-houses. In this country it was the practice to employ practically unskilled labour, but in America it was becoming usual for technical graduates to commence their careers in the boiler-house, and the results justified this arrangement.

Institution of Post Office Electrical Engineers.—A meeting of the London Centre will be held at the Institution of Electrical Engineers, on February 8th. Kinematograph films entitled "Audion-Thermionic Valves and their Application," and "Telephone Inventors of to-day," will be exhibited. The meeting is open to all officers of the Engineering Department eligible for membership of the Institution; and members of the Telegraph and Telephone Society of London. Members may introduce visitors to the meeting.

Edinburgh Electrical Society.—At a meeting of the Society, held on January 27th, a paper on "Country-House Plant" was read by Mr. T. S. Munnoch. The conditions which governed the class of wiring, size and voltage of plant, were considered. The prime movers—water, steam and internal-combustion engines—were compared. The lay-outs of various engine rooms were described, and the author gave examples from his experience of difficulties which had arisen in the course of erection or running of such plant. Mr. D. S. Munro presided and intimated to the younger members the conditions applying to apprentices' papers, which are to be read on February 10th.

Institution of Welding Engineers.—Members of the various sections of the welding industry at a meeting, held on January 26th, at the Holborn Restaurant, adopted a proposal to form a new welding society embracing all systems of welding. A strong Committee, with power to add to their number, representing the different interests, was elected to draft the Constitution with a view to registration after approval by a general meeting which will be called at an early date. The name agreed upon is the Institution of Welding Engineers, and all interested in the welding and allied industries will be eligible for membership. The temporary offices are at 30, Red Lion Square, London, W.C.1.

Greenock Association of Electrical Engineers.—At a meeting held on January 25th, Mr. George C. Reid, Glasgow, read a paper on "Wireless Telegraphy" and illustrated his points with the aid of a wireless set fitted up in the lecture hall, the aerials being strung across the ceiling. Mr. Reid was ably assisted by Miss Knowles, Greenock, who gave an interesting account of a wireless set she had erected and put into operation. A discussion on wireless power transmission followed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

CARL G. SCHLUEDERBERG, assistant to the manager of the Supply Department, Westinghouse Electric & Manufacturing Co., left New York City recently on an extended trip to South America. He will spend three months in studying electrical merchandising business conditions in Latin America in the interests of the Westinghouse Electric Co., and will visit Chile, Peru, Uruguay, Paraguay, and Brazil.

MR. C. V. S. DICKINS, A.M.I.E.E., of the Bombay Electric Supply & Tramways Co., Ltd., Bombay, is returning to England on furlough in May next. He will reside at the Engineers' Club, London.

MR. HARRY RICHARDSON, corporation electrical engineer, Dundee, is on the list of the city's new Justices of the Peace.

The Times Berlin correspondent says that Dr. RATHENAU has been appointed Foreign Minister.

The *Review of the River Plate* says that the Metropolitan-Vickers Electrical Export Co., Ltd., is the latest of the well-known British electrical manufacturing companies to establish its own branch in Buenos Aires. It has acquired premises in Calle Peru 451-465, where it has offices, showroom and warehouse. The manager for South America for the interests of the Metropolitan-Vickers Electrical Export Co., Ltd., Mr. George Harlow, arrived there on December 20th, and took over his new duties. Mr. Harlow has had very considerable experience in the company's service in Sydney, Australia.

MR. ARTHUR S. MARKES, A.M.I.E.E., has resigned his position with the Simplex Conduits Co., Ltd., and has joined the Walsall Hardware Manufacturing Co., Ltd., Addison Bridge, Kensington Road, W., as London representative.

MR. ARTHUR J. CRIDGE, who has been associated with the Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester, has resigned his position of manager of the Transformer Sales Department in order to join the staff of the Brush Electrical Engineering Co., Ltd., of Loughborough. He will take over the sale of the transformers manufactured by the Brush Co.

Obituary.—SIR FRANCIS BARKER.—We regret to record the death, which took place at Cannes at the age of 57 years, after an operation and an illness of some months, of Sir Francis Henry Barker, a director of Vickers, Ltd. He was chairman of the Executive Council of the Russo-British Chamber of Commerce, and received the honour of knighthood in 1917 for services rendered during the war.

MR. C. S. ROWLAND.—The death took place on January 14th, at the age of 52 years, of Mr. C. S. Rowland, who had for the past nine years been electrician at Lee Manor (Bucks.). He was previously for upwards of 20 years on the staff of Messrs. Drake & Gorham, Ltd.

MR. ALEXANDER MCGEOCH.—The death took place at Acock's Green last week, at the age of 68 years, of Mr. Alexander McGeoch, a member of the firm of William McGeoch & Co., Ltd., electrical accessory manufacturers, Birmingham. The deceased was appointed an Officer of the Order of the British Empire in March, 1920.

Will.—The late MR. W. E. MANDELICK, of the Underground Electric Railway Co. of London, left £10,563 gross and £8,802 net.

NEW COMPANIES REGISTERED.

Hot-Plate Hardware Co., Ltd. (179,284).—Private company. Registered January 26th. Capital, £2,000 in £1 shares. To adopt an agreement with S. Mann and to carry on the business of makers of and dealers in hot-plates of all kinds, whether heated by electricity, gas, water, steam, or otherwise, kettles, saucepans, and all kinds of kitchen utensils, &c. The first directors are: S. Mann, Cranleigh, Surrey, house furnisher (chairman); T. Stone, Cranleigh, Surrey, house furnisher; H. F. Thorpe, no address given. Qualification, £50. Solicitors: J. E. Lickfold & Son, 17, Bedford Row, W.C.1.

Veco, Ltd. (179,210).—Private company. Registered January 23rd. Capital, £1,000 in £1 shares. To carry on the business of manufacturers of and dealers in electrical accessories, switchboards, magnetos, bells, batteries, accumulators, electric lamps, motors, dynamos, electroliers, electric light fittings, cable and flexible cords, bell wires and other electrical apparatus, and such woodwork as is required for use in connection therewith. The first directors are: C. L. Douthwaite, 8, Bankfield Road, Shipley, engineer; R. Lindley, Prudential Buildings, Bradford, incorporated accountant. Secretary: H. Simpson. Registered office: 6, Back York Place, King Street, Leeds.

India Association, Ltd.—The India Association, Ltd., has been registered as a "private" company with a nominal capital of £100,000 in £100 shares, to construct, improve, work, manage, or control, in the Indian Empire or elsewhere, public works and conveniences of all kinds, including railways, tramways, docks, harbours, piers, wharves, canals, reservoirs, embankments, irrigation, sewage, drainage, sanitary, water, gas, electric light and power installations, telegraph and telephone equipment, hotels, warehouses, markets, and public buildings; to carry on business as bankers, merchants, capitalists, promoters, underwriters, financiers, concessionaires, &c. The signatories to the Memorandum of Association (each signing for one share) are: T. O. Callender, Hamilton House, Victoria Embankment, E.C. (director Callender's Cable & Construction Co., Ltd.); E. W. Smith, 4, Central Buildings, Westminster, S.W. (chairman Metropolitan Carriage, Wagon and Finance Co.); H. E. E. Procter, 29, Great St. Helen's, E.C. (partner Killick, Nixon & Co.); F. Byrne, 4, Central Buildings, Westminster, S.W. (director Dorman, Long & Co., Ltd.); H. C. Levis, 83, Cannon Street, E.C. (chairman and managing director British Thomson-Houston Co., Ltd.). The first directors (to number not less than three nor more than ten) are to be appointed by the signatories. T. O. Callender signs as "subscriber and director." Qualification, one share. Remuneration (except managing director) as fixed by the company. Secretary: W. G. Hendrey, "Twyford," Twyford Lane, Caterham Valley. Solicitors: Drake, Son & Parton, 24, Rood Lane, E.C. The registered office is at Temple House, Temple Avenue, E.C.4. File number 179,224.

Charles Jones, Junior, Ltd.—Private company. Registered in Dublin, January 26th. Capital, £2,000 in £1 shares. To carry on business as electrical and mechanical engineers, contractors, manufacturers, &c. The first directors are: C. Jones, junr., "Kincora," Merrion Road, Ballsbridge, Dublin, electrical engineer; C. F. Beckett, 73, Pembroke Road, Dublin, builder and contractor. Secretary: C. Jones, junr. Registered office: 3, Aston's Quay, Dublin.

Sheffield Welders, Ltd (179,268).—Private company. Registered January 25th. Capital, £1,000 in £1 shares. To carry on the business of welders and cutters of metals and other substances by electricity, oxy-acetylene, or other similar process, &c. The first directors are: W. B. Hughes, 41, Cavendish Street, Sheffield; F. Unwin, 224, Ecclesall Road, Sheffield. Qualification, £100. Registered office: 619, Carlisle Street East, Sheffield.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Reading Electric Supply Co., Ltd.—Trust deed dated December 31st, 1921, to secure £100,000 debenture stock, charged on certain freehold and leasehold hereditaments and the company's undertaking and property, present and future, including uncalled capital. Trustees: British Trusts Association, Ltd.

Rapid Magnetting Machine Co., Ltd.—Deposit on January 17th, 1922, of deeds of 48, 50, & 52, Lombard Street, Birmingham, to secure all moneys due or to become due from company to Barclay's Bank.

Yorkshire & District Electric Lamp Repairing Co., Ltd.—Mortgage dated January 2nd, 1922, to secure not more than £1,500, which the mortgagees may pay under their guarantee to company's bankers, charged on land with Heeley Mill, &c., thereon, in Saxon Road, Heeley, Sheffield. Holders: H. J. M. Cockayne, A. S. Lee, A. C. Davy, and V. B. Vickers, all of Sheffield.

Nairobi Electric Power & Lighting Co., Ltd.—Satisfaction to the extent of £1,000 on December 31st, 1921, of debentures dated September 10th, 1913, and July 26th 1915, securing £20,000.

Rawlings Bros., Ltd. (67,908).—Return dated September 29th, 1921. Capital, £100,000 in £1 shares. (70,000 ordinary and 30,000 preference.) 50,744 ordinary and 20,685 preference shares taken up. £71,429 paid. Mortgages and charges, nil.

Ackroyd & Best, Ltd. (54,600).—Return dated August 23rd, 1921. Capital, £25,000 in £5 shares. (3,200 preference and 1,800 deferred.) All shares taken up. £15,500 paid on 3,100 preference and £9,500 considered as paid on 100 preference and 1,800 deferred. Mortgages and charges, £48,400, sealed debentures.

Southern Brazil Electric Co., Ltd.—Particulars of £194,500 8 per cent. notes (including £176,500 already registered) authorised by resolutions of January 19th and June 24, 1921, and January 4th, 1922. Present issue, £18,000. Charged on the company's undertaking and property, present and future, including uncalled capital, subject to £750,000 6 per cent. first mortgage debentures.

Yorkshire Cable Co., Ltd. (99,015).—Return dated December 28th, 1921. Capital, £20,000 in £1 shares. 13,100 shares taken up. £13,100 paid. Mortgages and charges, £7,000.

CITY NOTES.

Stock Exchange Notices.—The Committee has ordered the following to be officially quoted:—

Mexican Electric Light Co.—5,567,000 dols 5 per cent. first mortgage gold bonds (endorsed), within Nos. C1 to 1,100 (100 dols), D1 to 3,050 (500 dols), and M1 to 4,400 (1,000 dols), in lieu of the deposit receipts now quoted.

Mexican Light & Power Co.—11,340,500 dols 5 per cent. first mortgage gold bonds (endorsed), within Nos. 1 to 14,000 (500 dols and 1,000 dols); and £1,000,000 5 per cent. second mortgage fifty-year bonds (endorsed) (Nos. 1 to 10,000), in lieu of the deposit receipts now quoted.

Mexico Tramways Co.—10,298,000 dols general consolidated first mortgage fifty-year five per cent. gold bonds (endorsed) (Nos. A1 to 3,750, 1,000 dols, B7,501 to 16,196 and 16,201 to 16,800, 500 dols, and C16,601 to 35,500, 100 dols); and £1,250,000 6 per cent. fifty-year mortgage bonds (endorsed) (Nos. 1 to 12,500, 100 dols), in lieu of the deposit receipts now quoted.

Pachuca Light & Power Co.—£800,000 5 per cent. first mortgage fifty-year bonds (endorsed) (Nos. A1 to 7,000, £100, and B1 to 5,000, £20), in lieu of the deposit receipts now quoted.

Dublin United Tramways (1896), Ltd.—The directors recommend payment of dividends as follows, less income tax, for the half-year ended December 31st: 6 per cent. per annum on preference and 7 per cent. per annum on ordinary stock, making, with the interim dividend paid in July last, 5 per cent. for the year. £35,000 is set aside for renewal of track, and £12,478 is carried forward. Last year £30,000 was set aside for track renewal; £2,000 was taken off in respect of depreciation of investments; the dividends were 6 per cent. on preference and 7 per cent. on ordinary shares, both less tax, making 5½ per cent. per annum, and the carry forward was £13,331.

City of Buenos Ayres Tramways Co., Ltd.—Balance dividend of 1s. 3d. per share, making 5 per cent. per annum, less tax, placing £2,000 to general amortisation fund, and carrying forward £7,389.

Westminster Electric Supply Corporation, Ltd.—Final dividend at the rate of 12 per cent. per annum, less tax, for the half-year, making 10 per cent. for the year.

STOCKS AND SHARES.

TUESDAY EVENING.

SOMETHING of a pause has occurred in the rush after investment securities. It may be that prices have reached levels at which even the eager investor hesitates before he cares to make further purchases. In the purely gilt-edged market, the trouble in India is certainly playing its part in producing an attitude of hesitancy. This influence is, of course, largely sentimental. It is supplemented by a good deal of quiet selling of the War Loan on the part of the people who see a reasonable profit, and who are content to sell, awaiting a favourable opportunity for using the money later on. Industrial debentures, more especially those in the electrical industry, show such strength as to emphasise the view that these stocks have got into the hands of permanent holders who prefer rather to increase their holdings than to sell them. The increasing pressure of tax-collection adds another reason to the catalogue of those which give pause to employment of money that the Inland Revenue is endeavouring to divert to itself. But sound stocks, not only in the debenture and preference classes, remain exceedingly firm. Illustration is afforded by the further string of rises which have occurred, for the second successive week, in the shares of the electricity supply companies.

Westminster ordinary at 6¼, County preference 8¾, City Lights 36s., both classes of London Electrics, Metropolitan preference and South Metropolitan 7 per cent. preference are all better on the week. South Metropolitan 2nd preference advanced also to 17s. 6d., St. James's preference to 5¼, and Westminster preference to 3¾. The difficulty is to supply the would-be purchasers, and the strength of the market includes provincial issues as well as those confined more particularly to London. Reading Electric 7½ per cent. debenture has risen to 6½ premium, while Llanelly debenture remains firm at 3½ premium. Fife Tramway Electric debenture has been over 5 premium, but reacted to 4¾ premium, this (Tuesday) afternoon. Newcastle-on-Tyne 2nd debenture stock touched 87½ before it reverted to 87¼. British Thomson-Houston after being better, finished at 5¼ premium. Midland Counties Electric 7½ per cent. debenture stock has risen to a trifle over 100. There is little stock to supply the persistent demand, and the lists of stocks which the jobbers have to offer seem to grow more bare each week.

Indian securities of all kinds are amongst those which are readily obtainable at the moment. The aspect of affairs in the Dependency is regarded as grave, and is having an important effect upon markets generally. Calcutta Electric Supply ordinary shares have gone back to £1, Madras Electric Tramways to 2⅜, while the shares of the Madras Electric Supply Corporation gave way to 15s., the preference to 13s. 9d. Auckland Electric Supply 5 per cent. tax-free preference shares can be obtained at 19s. 3d., giving a return of £5 3s. 6d. net, equal to nearly 7½ per cent. gross, taking tax at 6s. in the pound. Dividends are due in March and September. Amongst the debentures still on offer are the 8 per cent. secured bonds of the Barcelona Traction, Light & Power Co. obtainable at 96, giving a return of £8 6s. 6d., with interest due in January and July. Annual drawings start at 106 five months hence. Having regard to the disturbed state of some of the Spanish cities, the security, of course, possesses elements of speculation. North Metropolitan Electric Power Supply 7½ per cent. debenture stock has gone up to 103½, at which the yield is 7¼ per cent. on the money, while ¼ per cent. more can be obtained by the purchase of Shropshire, Worcestershire and Staffordshire Electric Power 7½ per cent. guaranteed convertible debenture stock, obtainable at 102.

Vivacious dealings in Radio Corporation shares stand out as the particular feature of the wireless market. The common shares rose to practically £1, while preferred were up to 14s. 6d., before reaction took them to 18s. 6d. and 12s. 6d. respectively. These two prices, it may be noted, together make 31s., which represents the value of one American Marconi share. The buying of Radios emanated entirely from New York, and was accompanied by no definite reason. But, putting two and two together, some in the Stock Exchange agree that there may be found some explanation in the fact that this activity started about the same time that the Commission over here issued its Report upon wireless affairs. The shares of the parent company have scarcely moved from 35s., but Canadian Marconis improved to 8s. 6d. before they gave way to 7s. 9d., and Marconi Marines at 23s. are distinctly higher on balance.

Great Northern Telegraphs are 10s. up at 26½. Anglo-American Telegraph preferred gained two points at 91, and the Eastern group is strong throughout, Eastern ordinary being up to 170. Cuba Submarines at 7½ are 5s. higher, Chile Telephones at 5⅞ are equally better, and the market shows conspicuous strength.

Amongst foreign tramway and traction descriptions, Anglo-Argentines stand out with rises to 2½ and 3½ for the first and second preference respectively, while the 5 per cent. debenture stock is four points up at 70½. Brazil Tractions at 33 have lost the two points which they gained last week. Mexicans are again better, a more cheerful sentiment pervading the Mexican outlook as a whole, and the issues of the Utility companies adding fresh points to those which they gained a week ago. Mexican Light & Power common shares are 3 up, and the bonds are mostly 1 to 3 better.

General Electric ordinary shed a few pence at 19s. 6d., but the preference are 1s. higher at 9s. 3d. Various vague reports gained circulation during the last fortnight, which hinted, at any rate, that there might be a new issue in contemplation, but these have been contradicted.

Babcock & Wilcox, after bracing up to 2⅝, went back to 2.9/16, leaving the price unchanged on the week. The tendency in the manufacturing market is towards higher prices. Electric Construction debenture at 56 is 2 points up. Rises have occurred in British Insulated, Callenders, Henleys preference and Metropolitan-Vickers preference, the last-named being advanced on the news that the company has secured, in the face of competition, an important contract for locomotives in South Africa. This served to strengthen the price of Vickers ordinary, which rose to 9s. 3d., but failed to hold the full improvement. Other armament, iron and steel shares show a disposition to ease off. Rubber shares are uninteresting.

Home Railways are attracting more attention than usual, but Undergrounds exhibit no great change. The Income Bonds are one down, and Metropolitan ordinary is one higher at 29¼. Prior-charge stocks are well maintained, though the demand for such securities slackened as the War Loan, and its immediate circle of stocks, fell back from the recent best.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend. 1919.	Dividend. 1920.	Price Jan. 31, 1922.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	12	12	6⅝	—	£9 1 2
Charing Cross Ordinary	7	8	4¼	—	8 8 6
do. do. do. 4½ Pref.	4½	4½	2¾	—	6 18 6
Chelsea	4	6	3¼	—	8 5 6
City of London	13	14	1⅝	+6d.	9 6 8
do. do. 6 per cent. Pref.	6	6	19/-	—	6 6 4
County of London	8	8	9⅛	—	8 8 6
do. do. 5 per cent. Pref.	6	6	8¼	+ ⅛	7 2 10
Kensington Ordinary	7	9	5⅛	—	8 11 6
London Electric	2½	2½	1 7/16	+ 1/16	6 6 9
do. do. 3 per cent. Pref.	6	6	8½	+ ⅛	9 4 7
Metropolitan	6	7	4¾	+ ⅛	7 15 7
do. 4½ per cent. Pref.	4½	4½	3 5/16	+ ⅛	7 1 2
St. James' and Pall Mall	12	12	7	—	8 11 6
South London	6	7	2⅜	—	10 9 0
South Metropolitan Pref.	7	7	1	+ ⅛	7 0 0
Westminster Ordinary	10	10	6¼	—	7 13 10
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	91	+1	6 11 10
do. Def.	1½	1½	19	—	9 8 6
Chile Telephone	6	6	5⅝	+ ⅛	5 11 7
Cuba Sub. Ord.	7	7	7½	+ ⅛	9 18 1
Eastern Extension	10	10	16⅝	+ ⅛	5 18 6
Eastern Tel. Ord.	10	10	170	+2½	5 17 8
Globe Tel. and T. Ord.	10	10	17	—	5 17 8
do. do. Pref.	6	6	9⅞	—	6 1 6
Great Northern Tel.	22	24	26½	+ ½	8 19 2
Indo-European	10	10	30½	—	8 5 4
Marconi	25	15	1¾	—	*8 11 6
Oriental Telephone Ord.	12	12	2	—	*6 0 0
United R. Plate Tel.	8	8	5⅛	—	*6 6 9
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	17	—	*5 17 8
Home Rails.					
Central London Ord. Assented	4	4	57	—	7 0 4
Metropolitan	1½	1½	29½	+1	5 1 8
do. District	Nil	Nil	23½	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	—	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. Income	4	2	73½	—1	*4 1 8
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	5½	12½	9⅞	+ ⅛	9 11 4
do. do. 2nd Pref.	Nil	5½	3½	+ 1/16	8 19 6
do. do. 5 per cent. Deb.	5	5	70½	+4	7 1 10
Brasil Tractions	Nil	Nil	33	— 2	Nil
British Columbia Elec. Rly. Pfce.	5	5	60½	—	8 5 4
do. do. Preferred	5	93/-	58½	—	*7 18 0
do. do. Deferred	8	126/-	60½	—1	*10 3 10
do. do. Deb.	4½	4½	63½	—	6 16 0
Mexico Trams. 5 per cent. Bonds	Nil	Nil	59½	+3	—
do. do. 6 per cent. Bonds	Nil	Nil	29½	+1	Nil
Mexican Light Common	Nil	Nil	15½	+3½	Nil
do. Pref.	Nil	Nil	34½	+1	Nil
do. 1st Bonds	Nil	5	64½	—	7 14 8
Manufacturing Companies.					
Babcock & Wilcox	15	15	2 9/16	—	6 4 9
British Aluminium Ord.	10	10	16/6	—	—
British Insulated Ord.	15	15	14½	+ ⅛	8 17 10
Callenders	15	15	1 7/16	+ 1/16	9 13 0
,, 6½ Pref.	6½	6½	18/9	—	6 18 8
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	—	5/8	—6d.	—
do. do. 5 per cent. Deb.	5	5	62	—	8 1 4
Electric Construction	10	10	18/9	—	10 13 4
English Electric	8	8	9/6	—	16 17 0
do. Pref.	6	6	13/9	—	8 14 6
Gen. Elec. Pref.	6½	6½	19/3	+1/-	6 15 1
do. Ord.	10	10	19/6	—6d.	10 5 4
Henley	15	15	1 7/16	—	9 13 0
do. 4½ Pref.	4½	4½	3½	+ ⅛	6 6 0
India-Rubber	10	—	1/6	—	—
Met.-Vickers Pref.	8	8	1⅛	+ 1/16	8 10 8
Siemens Ord.	10	10	22/-	—	*9 1 10
Telegraph Con.	20	20	28	—	*5 4 2

* Dividends paid free of Income Tax.

THE PHYSICAL SOCIETY OF LONDON.

TWELFTH ANNUAL EXHIBITION.

(*Continued from page* 136.)

A complete line of new and improved alternating-current instruments has been patented and successfully developed during the last two years by Mr. C. L. Lipman at the research Laboratory of Messrs. Nalder Bros. & Thompson, Ltd., and some fine examples of these were exhibited. Some technical information about the new principles on which these instruments are working was made public for the first time about four weeks ago, during a discussion on "Some Recent Developments in the Design of a.c. Instruments," before an informal meeting of the Institution of Electrical Engineers.

The new power-factor meters are constructed on the "component field" principle, according to which the production of a "resultant rotating magnetic field"—which is the cause of many large errors in phasemeters—is avoided by arranging the field-current coils with their axes parallel in different planes, the moving system comprising a spindle and an appropriate number of thin iron vanes (specially shaped and set) mounted thereon in these parallel planes.

No resultant rotating field is set up by this construction, and consequently the "rotational drag torque" upon the moving system is not produced and the disadvantages arising from that torque are obviated. The principle is perfectly general, and permits the construction of power-factor meters for polyphase unbalanced-load circuits as well as for balanced-load two- and three-phase circuits, and for single-phase circuits.

It is claimed that with this improved construction accurate indications are obtained at all currents between one eighth and full load. Other advantages are an extremely light movement, very small volt-ampere consumption, efficient air damping, high torque, and perfect freedom of rotation of pointer,

Fig. 17.—Power Factor Meter.

giving a 360-degree scale of theoretical shape as illustrated in fig. 17.

The "Nalder-Lipman" rotary synchroniser was exhibited in two sizes, 8 in. and 12 in. dial, fig. 18, but a third size, 20 in. dial, is also being manufactured. These instruments are similar in construction to the single-phase power-factor meter, except that the current coils of the power-factor meter are replaced by pressure coils connected to the incoming machine, and the position of unity power factor corresponds to synchronism between the bus-bar pressure and that of the incomer. The pointer being free to rotate continuously, rotates in one direction or the other, according as the incomer is running above or below synchronous speed.

The special features of this new type of synchroscope are that it inspires confidence in the operator by the perfectly uniform and smooth rotation of the pointer over the dial, and that it does not "break out of step" for a considerable difference in frequency between the bus-bars and the incoming machine.

Other advantages are an extremely light moving system, very low power consumption, being only about 8 volt-amperes, thus necessitating only a small potential transformer, simple and robust construction, and exceedingly high torque. If desired, a green and red signalling device can be fitted to the instrument.

The Nalder-Lipman frequency meter for station use was shown in the 12 in.-scale sector pattern, giving about 2 inches deflection per period. The total range of this "Ideal" station frequency meter is 47 to 53 cycles per second, with 50 cycles as normal in the middle.

A multi-range round-pattern frequency meter for laboratory use was also exhibited, having three ranges and covering a total range of frequencies from 20 to 65 cycles, as illustrated in fig. 19. In this frequency meter a pointer deflects over an exceedingly open scale and indicates accurately the instantaneous value of the frequency of the a.c. system to which the instrument is connected.

The construction is in general similar to that of the Lipman-type synchroscope, except that all coils are connected across the same mains. For frequencies up to 100 cycles per

Fig. 18.—Synchroscope, 12-inch Size.

second one coil is tuned to resonance for a selected or normal frequency, but for higher frequencies a very open scale is obtained without the aid of electrical resonance. One of the most striking features of this instrument is the very open and long scale. The flexibility and simplicity with which any shape and length of scale can be obtained are remarkable. Thus the length of scale per period can be arranged to be anything from 3/16 in. to 4 in., according to requirements and to size of instrument.

The degree of accuracy claimed for this type of frequency meter is very high. The slightest change in frequency is instantly indicated by the pointer. No moving coils are employed, and all extraneous controlling forces due to conducting ligaments or brushes are thereby entirely eliminated. All coils are air-cored, hence the instrument is free from errors

Fig. 19.—Multi-range Frequency Meter.

due to saturation and losses in the iron. This instrument is independent of temperature variations. A variation of voltage of plus or minus 20 per cent. from the normal, for which the instrument is designed does not affect the readings by more than 1 per cent. The operating forces are exceedingly high, and permit the construction of graphic frequency meters.

Apart from the meters described above, a number of other interesting and important instrument were also exhibited by

Messrs. Nalder Bros. & Thompson. Amongst these was a highly sensitive alternating-current relay (fig. 20) patented by Fawssett & Parry, for use in connection with Merz-Beard and Merz-Hunter cable protection systems. An induction-type overload relay with adjustable inverse time limit, also reverse-current and reverse-power relays for alternating current, and

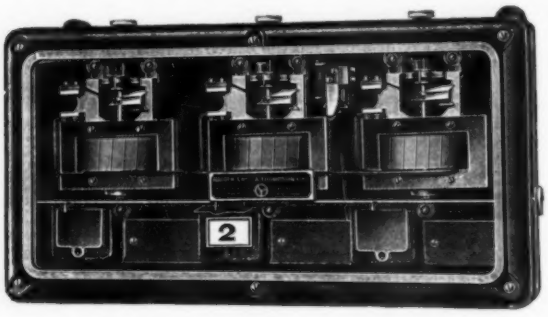


Fig. 20.—Sensitive Relay (Fawssett-Parry).

the "Ohmer" insulating-testing set of electrostatic type, possessing advantages due to its lightness and immunity from disturbances due to magnetic fields.

A collection of hyper-(long) scale ammeters (fig. 21) and voltmeters also attracted attention, whilst a complete line of port-

Fig. 21.—Hyper-scale Ammeter.

able instruments, including potential and series transformers for high and low pressure circuits, sub-standard wattmeters, voltmeters and ammeters, lamp and cell testers, maximum-demand indicators, &c., impressed visitors with their compactness, neatness of workmanship and excellent finish.

Messrs. Siemens Brothers & Co., Ltd., showed both suspended-coil and pivoted-coil temperature indicators and recorders of the wall and portable types. Also thermo-electric pyrometers with enclosed and exposed terminals respectively were to be seen on the stand, as well as a selection of primary cells and batteries.

The Weston Electrical Instrument Co., Ltd., exhibit comprised a selection of various types of a.c. and d.c. indicating and measuring instruments of both the laboratory and switchboard types; also testing devices, potential transformers, and typical moving parts, which showed the details of mechanical construction. The firm's work is of a high class and the instruments have a high degree of accuracy. It was noticed that the miniature precision d.c. instruments are growing in size, and the garage testing sets and small pattern instruments for use on motor cars, &c., are very useful. The typical a.c. scales of the milliammeters and ammeters used on small wireless telegraph and telephone sets are slightly congested near the zero, but the divisions approach uniformity over the greater portion of the scale.

The thermo galvanometers or "current-squared" meters have a sensitivity of 115 milliamperes and a resistance of 4.5 ohms. The scale has 50 divisions uniformly divided and figured from 0 to 100. This scale does not indicate the actual current flowing, but represents a value which is proportional to the square of that current. The instruments are extensively used on wavemeters and wherever decrement measurements have to be made.

The Model 400 radio-frequency thermo-ammeter consists of a heating element and a d.c. permanent magnet indicator calibrated to indicate directly the current passing through the heating element. These instruments are self-contained with either front or back connection studs for currents up to and including 100 amperes. Above 100 amperes external heating elements must be used. Ranges of 100 amperes or below are also supplied with external heating elements when desired, although for the lower ranges it is preferable to use the self-contained instrument. They are of equal accuracy whether they are used on audio or radio frequencies, and are guaranteed to be accurate within 1 per cent. of full scale value. Their use can also be extended to include measurements of currents where bad wave form or frequency precludes the use of other forms of instruments. They require only one-sixth as much power for their operation as do the ordinary hot-strip expansion type instruments.

Mr. H. W. Sullivan.—The majority of the exhibits on this stand had appeared at previous shows, but there were several of a novel character, from amongst which the following have been selected: The radio frequency bridge is suitable for the measurement of resistance, capacity, and inductance at radio frequencies. One of its chief advantages is the employment of a high-frequency generator, in place of the buzzer apparatus which has hitherto been used for determinations of this character, the use of which enables tests to be carried out under actual working conditions; the range of frequencies of the oscillator is between 10,000 and 500,000, the higher frequency representing a wave length of 600 metres. The set, we believe, is the first of its kind available for practical testing purposes and, it is hoped, will fill a long-felt want for the easy and accurate measurement of the quantities for which it is designed. It is not essential that all the components should be purchased at one time, as some of the higher capacities and inductances can be added later according to the nature and value of the measurements it is desired to make. A calibration chart is supplied with the oscillator to enable inductance and capacity values to be easily determined by a simple calculation.

The fixed air condenser (.001 mfd.) has been designed in conjunction with the National Physical Laboratory, and is made on the lines of standard condensers recently supplied to the laboratory. The chief feature is the elimination of all insulating materials other than the quartz, so that the condenser is all metal, and is, therefore, less liable to be affected by temperature than an instrument built up of insulating materials. In addition, the metal cover forms a perfect earth screen, metal caps being fitted over all the insulators to render the screening complete. Further, quartz was selected from a number of insulating materials as its dielectric losses are less than any other, with the exception of amber, which was employed for the insulators used in a large condenser supplied to the National Physical Laboratory, but owing to the difficulty in obtaining amber in the sizes required for the insulators, it was superseded by quartz. The National Physical Laboratory has recently carried out a number of tests on these condensers, which were made for a Government Department, and reported that "they are the most perfect condensers ever made."

The thermionic valve generator for very low frequencies consists of coupled circuits using iron for frequencies of from 3 to 400 periods. The frequency is varied by means of a condenser connected across appropriate terminals, a chart being supplied showing the capacity values for different frequencies. Two valves are used in parallel and the input is about 12 watts and the output about 2 watts, which is quite sufficient for supplying the necessary current for general testing purposes. The advantages of using an a.c. oscillator, as compared with a generator, are obvious. A further range of oscillators was shown for generating frequencies of from 400 to 10,000 cycles and the radio frequency oscillator from 10,000 to 500,000 cycles.

Major Tucker's patent hot-wire resonator microphone was originally designed for determining the position or origin of a sound produced by the discharge of a gun and was largely used during the war period, forming the subject of a secret patent. It has since, however, been applied to a number of other purposes, for the detection and measurement of sounds emanating from sources other than gun fire.

The microphone consists of an electrically-heated Wollaston wire, or grid, which is mounted close to, and in front of, a small opening in a cylinder, or container, the latter being closed at the other end, the volume of air in the container being variable by means of a plunger operated by a micrometer screw. The fine wire which is supported in a frame is connected to terminals. An electric current is passed through the wire for the purpose of raising its temperature above that of the surrounding air. In operation the temperature of the wire is reduced by the cooling effect of the blast of air caused by the sound to be determined or recorded, and if the ends of the wire are connected to a sensitive indicating galvanometer of the unipivot type, a deflection of as much as 90 degrees is easily observed, the deflection, of course, depending upon the intensity of the particular sound wave which is affecting the microphone. The variation in the electrical resistance can be used in many ways; the best effect, however, is obtained by inserting the microphone in the arms of a Wheatstone bridge which utilises to the best advantage any resistance variation in the microphone. In conjunction with an Einthoven galvanometer or other suitable instrument, it can be used for recording the wave form of sounds of low periodicity, *e.g.*, within the range of 25 to 1,000, or if connected through a transformer and used in conjunction with a valve magnifier, sounds can be rendered audible over great distances.

The universal laboratory standard heterodyne wave meter (150 to 20,000 metres) is claimed to be the first of its kind produced for commercial use. It is a self-contained laboratory standard for precision measurements of continuous and spark waves, covering the whole useful range of wave-lengths

without the addition of separate coils. The variable air condenser includes a fine adjustment of an entirely new and reliable design, thereby enabling simple short wave adjustments to be easily obtained. A special type of electro-magnetic interrupter is included for the production of interrupted continuous waves for spark adjustments. The current from the filament of the valve is supplied from a 6-volt accumulator; a 50-volt battery is necessary for the anode supply. The instrument is accurately calibrated against an N.P.L. standard. The workmanship throughout is of the highest order, and a full range of seven calibration curves is supplied with each instrument.

(To be continued.)

THE ELECTRICAL DEVELOPMENT OF OUTLYING DISTRICTS.

(Abstract of address delivered before the Institution of Electrical Engineers.)

On January 3rd, Mr. R. A. Chattock, chief electrical engineer to the Birmingham Corporation, and chairman of the South Midland Centre of the Institution, addressed members of the East Midlands Sub-Centre of the Institution at Loughborough, on the subject of "The Electrical Development of Outlying Districts," remarking, *inter alia*, that he had, in conjunction with the engineer to the Shropshire, Worcestershire and Staffordshire Electric Power Co., recently prepared a scheme in which the question of supplying the outlying districts of Birmingham with electricity was a prominent one, and the general proposal was to run an extra-high-pressure loop main through them so that a supply could be obtained from two sources, ensuring reliability.

In order to decide what type of supply should be given to outlying districts, regard must be had to the nature of the main supply from which it was derived. Usually the latter was given at a periodicity of 50 cycles per second, that type of energy proving suitable for lighting purposes, but in the South-West Midland area a periodicity of 25 cycles per second was standard. Lighting at that periodicity was suitable for industrial purposes, but other methods of supply in which no flicker was discernible were more desirable for private houses. The only alternative to a higher periodicity was the use of direct current, and Mr. Chattock dealt with the question under two heads:

(1) The distribution of direct current derived from rotary converter or mercury-arc rectifier sub-stations.

(2) The distribution of alternating current at a frequency suitable for residential lighting purposes.

For domestic purposes the use of an alternating-current distribution system at a pressure of 220 volts to earth undoubtedly created a risk of serious shock; the necessary precautions added materially to the cost of the apparatus, it being necessary to install a small auto-transformer on each piece of apparatus, so connected up that a pressure of not more than 50 volts to earth could be obtained from it. Little risk attended the use of alternating current (220 volts) simply for lighting a house, as there was less likelihood of the consumer coming into contact with the current. For small motors in workshops alternating current was less satisfactory than direct current.

From the point of view of safety and reliability, direct-current distribution was to be preferred to alternating current, and for some purposes (for example, the charging of batteries on motor-cars and electric vehicles) it was the only supply that could be used. With it a storage battery might be used, thus providing a source of supply independent of the main supply for a reasonable period and also having the effect of steadying any fluctuations which might occur on a large e.h.p. system.

Mr. Chattock then discussed the costs of different systems, assuming an area of about 13 square miles, say, nine miles long by 1½ miles wide, with an e.h.p. main running through it. Such an area would require three direct-current or six alternating-current sub-stations, and the total load on the area would be approximately 300 kW, 50 kW for each 2¼ sq. miles. The smallest size of mercury-arc rectifier being of 230 kW capacity, and the close spacing of the brush gear rendering automatic rotary converters liable to fail and to flash round on the commutator, combined to make it difficult to supply such an area with direct current. Further, the size of a static alternating-current transformer rendered it convenient for use. Supposing that approximately 600 kW of transforming plant would serve the district, a comparison of the costs of various schemes would be as follows:—

A.—Sub-station equipment.

(1) Three mercury-arc rectifier sub-stations comprising:—
Three 230-kW rectifier equipments, complete with switchgear.
Three 200-ampere-hour batteries for balancing purposes, with charging sets and switchgear.
Three direct-current feeder switchboards.
Three sub-station buildings.
Cost £21,400

(2) Three automatic rotary-converter sub-stations comprising:—
Three 250-kW rotary converters, arranged for neutral point balancing with transformers and switchgear.
Three direct-current feeder switchboards.
Three sub-station buildings.
Cost £20,000

(3) Six 50-period static transformer sub-stations supplied from a 50-period system comprising:—
Six 100-kW, oil-cooled static transformers with high or low-pressure switchgear.
Six small sub-station buildings.
Cost £3,600

(4) Six 50-period transformer sub-stations supplied from a 25-period system comprising:—
Three 250-kW motor generators with exciters and switchgear.
One suitable building.
Cost £12,000
Static transformer equipment as above ... £3,600
Total ... £15,600

B.—Distributing Mains

For a d.c. distribution system, assuming a maximum drop of 4 per cent. in voltage, the cost would be £23,800. For an alternating-current distributing system, the cost would be £12,000. The total costs therefore would be:—

(1) Mercury-arc rectifier sub-stations.
Three rectifier sub-stations with direct-current mains £45,200
(2) Three rotary converter sub-stations with direct-current mains £43,800
(3) Cost of six 50-period static transformer sub-stations with alternating-current distributing mains off 50-period system £15,600
(4) Cost of six 50-period static transformer sub-stations with a.c. distributing mains, off 25-period system ... £27,600

The expense did not end with the capital costs—table 1 showed the efficiencies of operation on a 15 per cent. load factor, and a 25 per cent. load on the transformation plant:—

TABLE I.—Efficiencies of Operation.

Scheme.	Efficiency, %.	Value of kWh lost at ½d. per kWh.	Value of capital charges at 10%.	Total cost of transformation and distribution.	Cost of transformation and distribution per kWh to consumer.
					d.
1	89	£150	£4,520	£4,670	2·86
2	84·5	225	4,380	4,605	2·80
3	95	66	1,560	1,626	0·992
4	68·5	560	2,760	3,320	2·04

It was evident that from a 50-period system of supply it was economical to develop outlying districts by means of static transformers run on the same periodicity, whilst from a 25-period system there was little difference as regarded the ultimate cost to the consumer between direct current and alternating current, assuming that the 25-period supply was transformed to a 50-period one before distribution. When a district developed, the efficiency of the direct-current transformation would improve to a greater extent than the efficiency of the alternating-current transformation. On the other hand, it should be borne in mind that the building-up of the supply was a gradual process, and that alternating-current distribution lent itself to less costly equipment at the outset. Therefore, the speaker was of the opinion that a 50-period alternating-current system of distribution was advisable for sparsely-populated outlying districts.

The discussion following the paper was contributed to by Messrs. F. S. Grogan (Loughborough), P. Schofield (Loughborough), E. G. Boissier (Derby), A. H. Laurence (Loughborough), H. A. Nevill (Peterborough), J. F. Driver (Loughborough), F. Forrest (Birmingham), and T. P. Wilmshurst (Derby), and others.

Mr. Chattock stated that ½d. per kWh must be added to the costs in his table to ascertain the total cost to the consumer in a private house. With a direct-current system the batteries used required attention, it being necessary to replace the positive plates every five or six years and the negative ones every eight or ten years. The question of safety was discussed; a lower pressure than 220 volts would minimise the risk. Although the Act of 1919 empowered electricity undertakings to install electricity in houses on a hire basis system Mr. Chattock did not consider the scheme practical at present and doubted the possibility of an adequate financial return for the outlay.

THE ELECTRIFICATION OF MAIN-LINE RAILWAYS.

AN important joint meeting of the Midland branches of the Institutions of Civil, Electrical, and Mechanical Engineers was held in Birmingham on Friday, January 20th, to discuss the subject of "The Electrification of Main-line Railways." By kind permision of the Lord Mayor of Birmingham (Ald. David Davis), the meeting took place in the Council Chamber of the Council House. The chair was occupied by Sir Henry Fowler, K.B.E. (Chief Mechanical Engineer, Midland Railway), and he was supported by Mr. R. A. Chattock (Chairman of the South Midland Centre of the Institution of Electrical Engineers), Mr. E. C. R. Marks (Chairman of the Midland Branch of the Institution of Mechanical Engineers), and Mr. A. W. Willett (President of the Birmingham Association of the Institution of Civil Engineers). There was a crowded attendance, and extraordinary interest was evinced in the discussion. Arrangements had been made for the following gentlemen to open the discussion:—

Mr. W. Willox, M.Inst.C.E. (late Chief Engineer, Metropolitan Railway);
Mr. C. F. Bengough, M.Inst.C.E. (Chief Engineer, North Eastern Railway);
Mr. Roger T. Smith, M.I.E.E. (Chief Electrical Engineer, Great Western Railway);
Mr. F. W. Carter, M.A., M.I.E.E. (British Thomson-Houston Co., Ltd., Rugby);
Mr. H. N. Gresley, C.B.E., M.I.M.E. (Locomotive Engineer, Great Northern Railway);
Mr. J. A. Hookham, M.I.M.E. (Locomotive Engineer, North Staffordshire Railway);

and towards the end of the meeting the discussion was thrown open to other speakers.

SIR HENRY FOWLER, in his opening remarks, said it was very right that a discussion on that subject should take place at that particular time. All over the country inquiries were being held as to the future arrangements for the supply of electricity. If a clear lead could be given as to the demands which were likely to be made for transport, it would be of the greatest advantage.

As regarded electrical and mechanical considerations, he felt that their difficulties were few, always assuming that they neglected the question of expense. On the civil engineering side, he had recently received from his friend, Mr. A. W. Gibbs (Chief Mechanical Engineer, Pennsylvania Railway) a reprint of the *Journal* of the Franklin Institute of October last. This contained a copy of his paper on "Some Mechanical Characteristics of High-Speed, High-Power Locomotives." In this he detailed experiments made on the Pennsylvania Railroad in 1907 to ascertain chiefly the effect of steam and electric locomotion on the road itself, and the conclusion arrived at was that the best arrangement was a high centre of gravity and an unsymmetrical wheel arrangement. In a letter the speaker had just received from him, he said that nothing had occurred to change his "views concerning the disadvantages of the low centre of gravity and the short wheel-base truck as an unstable arrangement." This was a most important point. They knew that a satisfactory service could be carried out, but must be convinced that it was satisfactory financially. Many lines had a low density of traffic, and there the first cost was a very great consideration. A still larger question was that of the cost of change-over and the present financial position of the country.

MR. W. WILLOX said it was being gradually realised by those in authority that electrification must come, though perhaps piecemeal. Since 1913 prices and wages had mounted very high, and had caused passenger and freight prices to be raised to such an extent that the railways were losing traffic and the trade of the country was being injured. Further, competition from road traction had arisen, and was as serious as was competition from electric tramways and motor 'buses before the war. The former was to catch traffic being lost by the railways, the latter was lost to the railways by more speedy modes of locomotion. Gradually suburban railways were electrified at a considerable cost (mostly due to each railway having to provide its own power station) with the object of regaining lost traffic—and it was successful. In London, the Metropolitan District Railway was electrified, and the Metropolitan; in Newcastle, the N.E.R. electrified its local lines; the L. & Y., the Midland to Heysham; the L.B. & S.C. Railway, and lately the L. & S.W. and the L. & N.W. Railways had done the same, as had also the Mersey Railway.

The Metropolitan Railway in 1913 carried nearly 122 million passengers; in 1919, 182 millions. The L. & Y. trebled its traffic. Sir W. Forbes, of the L. B. & S.C. Railway, stated quite recently that his electrified lines brought 150 per cent. more traffic and 200 per cent. more money, and showed on the capital expended a return of over 15 per cent. Now he wanted to electrify the main line to the coast towns. The East London Railway—in the electrifying of which the speaker had a hand—connected the G.E. Railway, the Metropoiitan, and the Metropolitan District Railway in the North with the L.B. & S.C. Railway and the S.E. & C. Railway in the south. This line was electrified without interfering with the traffic. Up to 1913 it was worked by steam, and carried 5,506,664 passengers; after that the number of passengers steadily increased, and in 1920 the number was 16,307,382—an increase of 194 per cent. The L. & S.W. electrification increased the passenger traffic by 100 per cent. In 1915 the N.E. Railway equipped the Shildon-Newport line, which, with sidings, was 50 miles long, with overhead electrical equipment. This line dealt with heavy mineral traffic drawn by powerful electric locomotives, five of which did the work of thirteen steam locomotives. In America there was a number of cases where main-line working had been and was being turned to electric working, with most favourable results, especially where there were heavy gradients and tunnels. In South Africa, the railway from Glencoe Junction to Pietermaritzburg, 171 miles, was to be electrified. All these cases were known, and their success was, no doubt, having its effect. Owing to the continuous increase of traffic into terminal stations, the question of accommodation arose. This might be solved by costly extension of the terminus or by electrification. The Metropolitan Railway hauled its main-line steam trains from seven or nine miles out by electric locomotives, and the same thing would have to precede main-line electrification in many cases. In economical working the electric locomotive had proved itself superior to the steam locomotive. Taking the whole cost of electrification, such authorities as Sir John Aspinall, Sir Vincent Raven, Sir Philip Nash, and Sir Philip Dawson seemed to favour the electric locomotive. Now that the Electricity Commissioners had (or soon would have) decided on the positions of the large power stations, the various railway companies that decided on main-line and suburban electrification would be saved the large cost of providing power for themselves. The cost of the electrification on such railways as the Metropolitan, including power houses and everything, was somewhere about £20,000 a mile pre-war. The cost of electrifying the East London Railway, which got power from Lots Road, was about £5,400 per mile pre-war; this included one new sub-station, conductor rails, and improvements to permanent way.

There was no engineering difficulty in electrifying existing steam railways, even when the traffic was dense, with either the contact-rail system or the overhead equipment. There was an opinion that at points and crossings the contact-rail system presented serious difficulties and danger to the maintenance gangs. In his experience, there was no special danger, and he knew of no cases on the Metropolitan Railway where men had been killed or injured when ordinary care was taken. On such lines all tools were insulated, and men got quite used to the work in a very short time. The cost of ordinary maintenance of a rail-contact line was found to be £12.64 per mile per annum. The re-building of Baker Street Station was a good example. There were over 600 trains a day in and out of the main-line part of the station. The old station was pulled down and every line in the station was altered in position. A new station and new offices were built on columns over the lines and platforms, and no serious accident happened to any men and no train was delayed.

The East London line—mostly in tunnel—was another example where the electrification was carried out while the traffic was carried on regularly, and with the added 2s. per week per man "juice" money, it amounted to £13 1s. per mile per annum. With regard to increase of staff, only one gang of five men was added, and this was in the densest nine miles of line in the open. The tunnel section was maintained at night. With power supplied for electrification, signalling could be electric or electro-pneumatic, and track-circuiting could be readily installed throughout, thus adding additional safeguards, and the sections might be lengthened or shortened in order to accommodate more trains. Power would be available for lighting purposes, especially for signals, the signals being lit by means of switches at the stations or signal boxes, thus saving staff. Fog signals might also be used, as on the Metropolitan Railway, and so save staff again, the fog signals being lit by the signalmen at the signal boxes.

MR. BENGOUGH said a very interesting paper had recently been read by the Chief Mechanical Engineer of the North Eastern Railway (Sir Vincent Raven), which dealt very fully with the case for the electric locomotive.* He gave an interesting comparison of the cost of repairs to electric locomotives working the Shildon-Newport line compared with the cost of repairing the steam engines which previously worked the traffic; the cost of the electric locomotive being 1.316d. per mile, compared with 5d. in one case, and 5.5222d. in another for steam locomotives. There was a great deal to be said for electrification, provided the necessary power could be obtained at a cheap rate. The problem of equipping a main line of railway was quite different from the case of a suburban line, where the electrical working was confined to passenger traffic, as in the Tyneside area. In electrification of the main line the aim would be to work all traffic, both passenger and goods, electrically, and it would therefore be necessary to electrify certain portions of the sidings of all stations and goods yards to enable engines to take and deliver their loads. In the case of a line electrified on the third-rail system, in order to make the sidings safe for shunters to work

* ELECTRICAL REVIEW, December 30th, 1921, and January 6th, 1922.

on, the third rail would have to be very fully protected, and would form a very serious obstruction, and overhead equipment would appear to be the only practical form where shunting had to be carried on.

The following appeared to be the advantages and disadvantages of overhead and third-rail equipment :—

Third-Rail Disadvantages.—Increased difficulty in maintaining the track, the third rail forming an obstruction to the packing of the sleepers and generally slowing-down the work owing to the care that had to be taken by the men to avoid shock. This would be emphasised in the case of a high-pressure such as 1,500 volts.

In the case of derailment occurring on the third-rail side, a comparatively slight displacement of a vehicle would wreck the third rail; for example, with a rail fixed with its centre 1 ft. 7¼ in. from the gauge line of the track, as was the case on Tyneside, a vehicle running derailed on the third-rail side a foot from the running rail would wreck the insulators carrying the third rail.

In addition to this, with a train worked with a single electric locomotive, difficulty would be experienced in the case of long gaps at level crossings or at junctions where owing to the arrangement of the points and crossings it was not possible to get a continuous rail, and where the length of gap would exceed the distance between the collecting shoes on the locomotive, and it would therefore be necessary at those points to erect a short length of overhead equipment or provide some other means of moving the train in the case of an engine which happened to be stopped on a gap.

Third-Rail Advantages.—The main advantage of the third rail was its accessibilty. Repairs could be carried out without the use of a special tower wagon, which would be required for overhead equipment. On the other hand, it must be remembered that to carry out any repairs to the third rail the current must be cut off, and theretore the line was as much electrically out of use as would be the case if it were occupied by a tower wagon.

In the case of accident, there was no obstruction of overhead wires to the working of breakdown cranes.

Overhead Disadvantages.—The overhead equipment was an obstruction to the working of breakdown cranes in the case of an accident, and the effect of heavy gales causing the contact wire to be blown off the engine bows had to be considered. Inspection necessitated the use of a tower wagon, thus occupying the line.

Overhead Advantages.—The maintenance of the track was not interfered with in any way, and could be carried out by the platelayers without any risk of accident.

In the case of derailment a considerable displacement of a vehicle must take place before it would foul the supports of the overhead equipment.

In the electrification of the portion of the North-Eastern main line which was under consideration it was proposed to employ a pressure of 1,500 volts, and with such a voltage it was considered desirable that if the third-rail system were adopted, the form of rail which could be most fully protected should be used. The three forms were the top contact, such as was used in the Tyneside area and on all the third-rail systems in this country (except the Lancashire and Yorkshire, Manchester and Bury, 1,200 volts, where Sir J. Aspinall's side contact was in use), and the under contact, which had not been used in this country but was in use on the New York Central and on the Central Argentine, and it was probable that with the under contact the most complete form of protection could be obtained, and in addition the rail was more fully protected from ice and snow.

With the under-contact system, however, there was some difficulty owing to the restrictions imposed by the load gauge of our railways in providing the necessary clearances between the top of the protection and the underside of the load gauge, and between the underside of the collecting shoe on the engine and the running rails.

The New York Central and the Central Argentine were not hampered by load-gauge restrictions to the same extent as the railways in this country. On the New York Central the centre of the third rail was 2 ft. 4½ in. from the gauge line of the track as compared with 1 ft. 7¼ in.—the present dimension on the N.E. Railway. The Electrification Advisory Committee laid down 1 ft. 4 in. On the Central Argentine the vertical clearance between the running rail and the underside of the load gauge was 7½ in., as compared with 6 in. on the North-Eastern Railway. The pressure on the New York Central was 600 volts and on the Central Argentine 800 volts.

With an under-contact rail it did not appear to be possible to get a greater clearance than 1¾ in. between the top of the third rail protection and the underside of the load gauge, and between the running rail and the underside of the contact shoe, and this might be reduced by—

(*a*) Wear of running rail;
(*b*) Wear of wheel tires;
(*c*) Wear of journal brasses;
(*d*) Sinking of chair into sleeper.

The sum of these wears might easily amount to an inch, and the normal clearance of 1¾ in. would be reduced to ¾ in.

In considering the question of a fully protected third rail with a pressure of 1,500 volts, he had lately made some experiments at the Aycliffe sub-station on the Shildon-Newport line. The experiments were made with a length of third rail fully protected with wood, and with another covered with a bituminous compound. The compound appeared to be the better insulator of the two, but both with the wood and the compound in wet weather, with 1,500 volts pressure, one would get a very heavy shock.

After careful consideration his view was that the balance of advantage was with overhead equipment; the question therefore arose: what was the cheapest form?

On the Shildon-Newport line, which was worked with overhead equipment, the gantries for carrying the overhead wires were composed of steel sections. The normal distance between the supports was 109 yd. (100 metres); this span on some of the exposed parts of the line had been found to be too long, and difficulty had been experienced in heavy gales owing to the contact wire having been blown off the collecting bows of the engines, and getting underneath the horns of the bows, and in many cases wrecking them, and it had been necessary over considerable lengths of the line to install intermediate supports. There were five wires for each track, viz., catenary, auxiliary, two contact wires, and one feed wire.

A cheap and efficient form of equipment for long stretches of track in the country where it was only necessary to span two lines was with supports formed of telegraph poles connected by a beam formed of channel sections for carrying the wires. Telegraph poles were, of course, largely used for this purpose in the States and on the Heysham-Lancaster line of the Midland Railway. The attachment of the wires to the beams could be very simply made, so that in case of their forming an obstruction to a breakdown crane they could be slid to one side, up to the supports, so as to clear the track.

As regarded span, probably a span of 65 yd. in exposed positions would be satisfactory, and in deep cuttings where there was natural protection this might be increased.

Part of the Shildon-Newport line was equipped with only one contact wire, and from experience he had come to the conclusion that that was all that was necessary. There also seemed to be no reason why the catenary should not be used as a feed wire, thus reducing the number of wires to two—a bronze catenary wire and the contact wire.

With this type of construction he estimated that a line could be quite as cheaply equipped as with the third rail, and from experience with the third rail in the Tyneside area and with overhead equipment on the Shildon-Newport line, the maintenance costs appeared to show a considerable balance in favour of the overhead.

Mr. R. T. SMITH said that though experience with main-line electric locomotives was very limited in this country, there was enough to interpret much larger foreign experience in terms of British railway working. In his paper a month ago, Sir V. Raven gave a complete comparison within the limits of present knowledge between steam and electric locomotives. Within any of 50 odd British railway structure gauges, an electric locomotive could be built to haul the heaviest train of wagons that the draw gear would stand, or if the strength of the draw gear were ever increased, the heaviest train likely to be used for many years to come. For most of these structure gauges the largest and most powerful steam locomotive had already been built.

Even if the maximum sized steam locomotive had not been already reached on most railways, the heaviest locomotive axle load that the structures (bridges) could bear had been reached in the steam locomotive, for no increase of power of the steam locomotive could be obtained without increase of weight. The axle loads of the electric locomotive were much less because there was no boiler, and there were many driving axles. Although on the Continent, and to some extent in United States designs, an electric locomotive was used in which the rotary motion of the wheel was obtained from the rotary motion of the electric motors through connecting and coupling rods, such designs seemed unnecessary for Great Britain.

Reciprocating parts were impossible to balance completely and expensive to maintain. Where the rotary motion of the wheels of the electric locomotive was obtained from the rotary motion of the motors through gearing, balancing was complete, and the first cost of the locomotive a minimum. Maintenance costs on the Newport and Shildon branch of the N.E.R. were one quarter those of the corresponding steam locomotive, and on the Chicago, Milwaukee, and St. Paul railway one-fifth.

Even with pooling, the hours that the steam locomotive was in service could only be increased from 8 to about 12. The electric locomotive could be used for at least 20 hours out of 24 every day with pooling. As a result of this and other advantages, whereas each steam passenger locomotive could haul from 20,000 to 25,000 train miles per annum according to circumstances of traffic, each electric locomotive could haul from 40,000 to 50,000 train-miles; and whilst the steam goods locomotive could haul from 10,000 to 15,000 train-miles per annum, the electric locomotive could easily double this. On the Newport and Shildon, N.E.R., mineral line the electric locomotive train-miles were just double the steam train-miles.

The traffic result was that the same number of train-miles could be hauled by half, and less than half the number of electric locomotives required for steam haulage. On the Newport and Shildon line five electric locomotives now did work formerly done by 13 steam engines. On the Norfolk and Western Railway in the United States, where coal trains of 3,250 tons used to be hauled by 27 Mallet steam locomotives in one division, the same trains were now hauled by seven electric locomotives.

An important comparison between electric and steam locomotives was the relation of average to maximum speed. The steam locomotive was a constant-output machine, exerting the maximum draw-bar pull between stand-still and a very few miles per hour. After that the draw-bar pull decreased as the speed increased, following a hyperbolic curve. Consequently, the steam locomotive could only go slowly up a gradient, and to keep to an average of, say, 50 m.p.h. with gradients, the maximum speed must be sometimes, say, 80 m.p.h. With an electric locomotive provided with motors having a series characteristic, so long as the limiting temperature for the type of insulation used was not exceeded and opportunity was given for cooling, the motor could be overloaded for short periods, say, 50 per cent. above its rating, and go up grades at double the speed of the steam locomotive. Consequently, in the electric locomotive the ratio of average speed to maximum speed was greater than in the steam locomotive, or in other words, for the same average speed the maximum speed of the electric locomotive was much less than the maximum speed of the steam locomotive. An electric locomotive of maximum speed 60 m.p.h. (after which troubles for both steam and electric locomotives began) could in general maintain average speeds about 50 per cent. greater than the corresponding steam locomotive. The result was a cheap single-reduction gear type of locomotive, whilst for higher speeds up to 80 m.p.h. single-reduction gearing could be used with motors above a quill round the axle spring-connected to the driven wheels.

Finally, with regard to the saving in cost of power, careful comparisons on the Chicago, Milwaukee, and St. Paul R.R. showed that 6¼ lb. of coal in a steam locomotive in 1915 was required to do the same work as 1 kWh of electricity in 1916. Generally coal costs now were 50 per cent. of the total *works* costs per kWh delivered to the track. If coal (including ashes) in the furnaces at the generating station cost 30s. (*i.e.*, 20s. at pit + 10s. per ton, or 0.16d. per lb.), the kWh works costs were 0.60d. delivered to the track. The above American experience made (assuming the same quality of coal) the equivalent power in a steam locomotive 1d., leaving 0.4d. to pay interest on the new capital.

Even if the coal consumed in a steam locomotive to produce the same haulage power as 1 kWh in the electric locomotive cost 0.8d. instead of 1d., *i.e.*, if only 5 lb. coal in the steam locomotive was required to do the same work as 1 kWh in an electric locomotive (instead of 6¼ lb.), still 0.2d. per kWh was left to pay interest on the capital cost of electrification.

On the North-Eastern Railway, experience showed that the cost of coal and water in each steam locomotive equalled the cost of power in each electric locomotive, plus the cost of maintenance of the electrified track per electric locomotive.

Since each electric locomotive in general did double the work of each steam locomotive, there would be, according to whether the traffic conditions were favourable or not to a large saving on the number of electric locomotives compared with steam locomotives, a balance which in particular cases not only paid interest on capital but left a handsome profit.

(*To be concluded.*)

INDUCTION-TYPE SYNCHRONOUS MOTORS.

Discussion at Manchester.

Mr. L. H. A. Carr, M.Sc (Tech.), read his paper on the above subject (which was abstracted in our issue of January 6th, 1922,) before the North-Western Centre of the Institution of Electrical Engineers on November 29th, 1921, and in discussing it Mr. E. P. Hill explained that the synchronous induction motor scored over the ordinary synchronous motor on account of the additional starting torque and the possibility of pulling into step. In the case of a direct-driven fluctuating load, would it not pay to arrange the machine so that it would not carry the very heaviest peaks without pulling out of step, as the machine would instantly pull in again and a cheaper machine would carry the load?

The reduced core losses of a synchronous induction motor (possibly due to a difference in field form) warranted further investigation, and the addition of a bibliography of references to earlier technical information on the subject would be of assistance.

Mr. A. B. Mallinson pointed out that the type of motor described would be very useful for big installations which generated their own power and were let down by their cables being overloaded, due to low power factor; its use would avoid spending money on re-cabling. Big installations which took power from a public supply and had too low a power factor would be forced by the supply authorities to install such machines, which should be used wherever the load was suitable, because it would benefit their networks. Supply authorities should say to the prospective customer: "We suggest you put in So and So's machine. It will be 1 per cent. lower in efficiency, but we will knock 1 per cent. off your bill. It will cost 40 per cent. more, but that we will pay."

Mr. Juhlin thought the author had shown how it was possible to overcome the difficulty of low power factor by the use of synchronous induction motors. The small extra cost of the motor was a consideration, but by co-operation with the power companies that could be got over. In some cases the synchronous induction motor was criticised because of its small air gap, as compared with the ordinary synchronous motor, but he did not think the complaint was justified. Experience had shown that with a synchronous induction type of machine, hunting was non-existent, due to the very excellent damping effect obtained from the rotor. He believed the synchronous induction motor would show a considerable saving over the ordinary type of induction motor with condensers, and there would be, in addition, the saving in space, as condensers needed a considerable amount of room.

Mr. G. S. Sills said they lagged very much behind some other countries. In 1910 in Canada the synchronous motor was extremely common, particularly for driving pumping plant. Even for small powers they automatically used synchronous motors, whereas in this country eleven years ago people would not look at them.

The Chairman (Ald. W. Walker) read a written contribution from Mr. William Stansfield, who did not think it desirable to work at too high a power factor on the motor on account of economically obtaining the required overload capacity. For some duties a 0.8 leading power factor was as high as it was desirable to go, and for others 0.9 was quite suitable, the latter figure being a suitable one for duties which did not demand any great excess of torque above the normal full load. It must not, of course, be understood that a 0.9 power factor motor had, of necessity, a low overload capacity; it was merely a question of obtaining the overload capacity economically in a given machine. In some cases, where a large amount of leading wattless kVA had been required, and only a relatively small amount of power had been demanded by the driven machinery, power factors as low as 0.3 leading had been allowed. Generally speaking, however, where a low leading power factor was desired, unless a heavy starting torque was required, the cheaper type, *i.e.*, the salient-pole machine, might be used. The somewhat heavier starting current required by the salient-pole machine and the necessity for using an auto transformer, sometimes prohibited its use where otherwise it could be installed. In such cases the type of machine under discussion was used.

There were various methods of winding and connecting the rotor according to the duty, &c., which the motor had to do. Where the starting torque was light compared with the kVA capacity of the motor considered as kilowatts, *i.e.*, at unity power factor, and where damper windings were not required, the plain single-phase winding was applicable. Where the starting torque demand was high enough to make a single-phase winding inadvisable, and the duty did not require a damper, the rotor could be wound with two phases out of three, *i.e.*, with no winding in the pole portion of the core, the motor being provided with three slip rings, and starting up as a two-phase rotor, thus killing the single-phase effect at half speed and enabling the motor to start up against heavy starting torques. Where a damper winding was necessary a two-phase winding could be used, consisting of the main winding occupying two-thirds of the perimeter, and an auxiliary winding in the remaining one-third. The auxiliary winding could be wound to give either the same voltage as the main winding, by using a smaller section of conductor, or the same section of conductor might be used and a lower voltage obtained in the auxiliary winding, which was an advantage, as the rotor would not then have to withstand such a high voltage across the outers, for, generally speaking, that type of motor was provided with three slip rings, one ring being common to the two windings. Damping could be arranged for economically by various other methods; it was very desirable in some cases and in others absolutely essential.

Mr. Mallalieu was of the opinion that the paper was extremely opportune; power factor correction was a very important question to-day, and he was sure it had added quite a lot to the cost, generally speaking, of distributing and selling electrical energy. If it paid to install synchronous condensers merely for the purpose of power factor correction, it must pay them very much more to use a machine which would correct the power factor and at the same time do very useful work as a motor. Many people did not realise the low power factors which prevailed, many of which were certainly partly due to inevitable causes, but many were largely caused by bad engineering. There was a prevalent mistake of installing a motor far too big for the job, and another prevalent cause was the putting in of low-speed motors. Higher-speed motors, in a lot of cases, with mechanical reduction gears, would improve the power factor.

The supply companies had the matter in their hands far more than anybody else. There was no question about it; the average user would not pay for synchronous induction motors, or for any method of improving the power factor, unless he could see some return for it, and it was up to the power supply companies to make him do it. The average system of charging for power was not up-to-date. He did not know that there was any great difficulty in producing a maximum demand indicator, but, if there was, a maximum ampere indicator should serve the purpose so long as the voltage was kept fairly constant. The doubling of the stator current when the machine was synchronising was rather a disadvantage.

Mr. Browning explained that the time for power factor correction was before one got the bad power factor, and it was at that point that the supply companies could help if

they would. An existing installation had rather a different point of view from that from which the paper was written. A synchronous induction motor might be very difficult to apply, and in all probability it might be found that it would be cheaper to put in a static condenser on the h.p. side of the transformers, and so please the power company, for it was the latter, and that alone, that would be influenced by such a proceeding, because generally one's own cables in the installation were of ample size for one's work.

MR. R. TOWNEND thought there was a big demand for a motor of the type described. Had it been better known generally there would have been far more in operation. There was no doubt there was a field for the salient-pole machine in preference to the induction-synchronous type. For small starting torques—say, for generators or motors which started with a friction clutch, the synchronous induction motor was slightly cheaper, and would give all the starting torque wanted with as small a starting current, as it would start with something like two-thirds full load kVA on the line. It enabled one to obtain a fairly high exciting voltage—an advantage, of course.

Regarding the cost of the motor being from 30 to 40 per cent. higher than that of an induction motor, was that based upon using an ordinary type of induction motor made into a synchronous motor? When making a synchronous induction motor the right thing was to design the machine as a synchronous induction motor and get the best starting torque. Bigger and open slots could be used, and so appreciably reduce the cost of the motor.

MR. D. S. PAXTON remarked that the power station people appeared to be absent. It might be that they had had wind of the suggestion that the price of a synchronous induction motor was from 25 to 40 per cent. higher than that of a plain induction motor, and did not wish to be in a position to contradict it. An advantage of the induction motor was undoubtedly that the commutator dealt with direct, and not with alternating current. In the d.c. commutator the troubles had been an absolute minimum.

MR. J. FRITH said that a rolling mill almost always depended upon a flywheel, and must have a motor with a large speed drop. As rolling mills had been spoken of as a particularly suitable load, the above point should be borne in mind.

MR. R. G. KILBURNE stated that it had been said that with a corrected induction motor the power factor lagged as the load decreased, but his experience with the Kapp vibrator type of phase-advancer showed that the power factor did not lag, but one had a greater leading power-factor down to about half load, and in many cases it was above unity down to at least quarter load. The phase advancer, when used in conjunction with the induction motor, greatly increased the overload capacity. In designing an induction motor for use with a phase advancer would it not be possible to cheapen the design by using bigger slots, making it really more of a machine, and correct the performance with the phase advancer? It seemed to be rather a disadvantage to have a large number of rectangular conductors per slot in the synchronous induction motor. Some difficulty might arise in the case of h.p. inverted machines. With salient-pole machines, when a large starting voltage was required, it was possible to run a machine not only up to the synchronous speed, but slightly above it, if necessary, and by that means reduce the leading current when synchronising. Where a lower starting torque was required—up to, say, full load, or 1½ times full load—it was possible by means of one of those machines to make use of a short-circuited rotor and a direct-current stator. That would appear to get over the difficulty of using inverted machines for h.p. work.

MR. T. BAXENDALE pointed out that very low power factors meant additional transformers, and at the station very often additional generators. Who was going to pay the capital charges of those—the interest on the cost? How could the synchronous induction motor be applied to certain auxiliary sets in stations? Was there a method of applying the design to existing motors of the totally-enclosed type, so that they could be put in the hands of a semi-skilled man?

MR. CARR, in reply, gave figures for an average machine, showing that the machine would pull into step with an enormous slip; it had a tremendous margin in synchronising power at full load, because it would run with just about 1 per cent. slip and could synchronise up to about 3¼ per cent. slip. The French General Electric Co. charged for reactive power at one-third of the price per kW for active energy; apparently it was charging according to power factor, but he had no information on how it metered the leading power factor.

The rotary condenser was a "rotten" machine. With regard to a highly fluctuating load, one should not design a machine of a lower overload capacity, and allow it to pull out of step. The only case where it might be possible to do so was that where a momentary load came on absolutely for a tenth or twentieth of a second, when the machine would slip one pole and no more, otherwise oscillations would be generated, and that was undesirable on the line, and usually undesirable on the drive.

Concerning the reduced core loss, that loss was about 70 per cent. of the loss when the machine was an induction motor. Further research was in progress with a view to finding out why that was so. It was certainly the fact with regard to the ordinary 3-phase motor. The synchronous induction motor was first invented by a man named Donaldson, in Sweden, in 1900. In 1902, the Swedish General Electric Co. patented the machine in Norway, Sweden, Switzerland, and the United States, and had manufactured it ever since. In this country the first experiments were undertaken by the Lancashire Dynamo Co., which, in 1906, made a machine and put it forward commercially about a year or two later. The author's firm, the British Westinghouse, started to make them about 1911. Since the Armistice other British firms had taken them up, and also Continental firms. In America nothing had been done with regard to synchronous induction motors.

As regarded bibliography, most of the references in the Press were not worth referring to. Low-speed machines would in future be made much more largely of the synchronous induction type. He was not anxious to unduly press the use of synchronous-induction motors where they had no business to be. So far nobody had devised a means of switching in at the right period of the rotor slip. The author was quite confident that it could be devised, but it was entirely unnecessary, because it would add considerably to the complication and expense of the switchgear for a thing which practically did not matter. Damping did not increase the time of coming into step; it decreased it if anything. It was not a hypothetical thing at all, but an induction motor effect; good damping meant very high induction-motor torque and small slip.

Regarding whether the cost was based upon an induction motor altered to form a synchronous, motor, or upon a synchronous induction motor designed as such, as a matter of fact it was an average of several alternative tenders which were prepared. Whether an ordinary every-day induction motor could be altered into a sychronous induction motor was all a question of overload capacity. If less output could be allowed one could do it; if not a new rotor or a new machine was necessary. There was no reason why a Cascade motor should not be made into a synchronous induction motor; and as regarded the application of synchronous induction motors to power station auxiliaries, there was no reason why totally-enclosed machines should not be used.

INDUSTRIAL RESEARCH.

THE Quarterly Review of Progress issued by the British Electrical and Allied Industries Research Association contains a record of the progress made recently in the several important researches conducted by this body. The work of the Association is carried out by Committees, each dealing with a different section of the work; the sections now number eleven.

Section A (fibrous insulating materials) covers research on fabrics (untreated and treated), papers, fibres and boards, varnishes &c. Specifications of the methods to be adopted in tests standardised for every kind of insulating material. The clauses covering mechanical tests are now under experimental proof; but the development of tests for electric strength has indicated the desirability of a wider series of tests applicable to all materials with a fibrous base, and even of a series of tests standardised for every kind of insulating material. The study of untreated papers has yielded results shortly to be published as a document covering the methods of examination and the definitions of the materials and terms employed. Specifications have also been drafted for the study of press-board, vulcanised fibre, varnishboard, &c., and are undergoing experimental verification; a full report of these researches is in preparation. New work in Section B includes the formation of a committee for research in varnishes; the co-operation of all having special knowledge of this subject is invited.

A comprehensive publication has been prepared of the test methods developed by the Association for the investigation and improvement of composite insulating materials. The publication includes a complete series of mechanical (*e.g.*, tool wear and chipping tests) and electrical tests, with the exception of tests for inflammability, flash point, fire resistance, dielectric losses, action of solvents, and surface breakdown. These are still under consideration, but in some cases the researches have reached the report stage. The Committee of Section C reports the completion of arrangements for porcelain research at Manchester University and the National Physical Laboratory.

The results of the work done by Section D on mica and micanite for commutators and condensers will shortly be available as a report. During this work there was found a general lack of physical data concerning certain features, and this has led to the institution of a research on fundamental constants, and the examination of the particular characteristics of certain micas. Arrangements have also been made for the publication of data obtained by the E.R.C. The manufacture of micanite is under consideration, and co-operation is invited from manufacturers and users.

The specification for insulating oils, prepared by Section E, and already submitted to the B.E.S.A., has met with substantial approval, and a final draft is under consideration. The researches on the electric strength and resistivity of insulating oils include the deterioration of oils by foreign matter, water, and products of arcing; particular interest is involved in the use of centrifugal apparatus in this research.

Work still continues on thermal transference, specific and latent heats, &c. (at the N.P.L.), and on the action of catalysers and the analysis of deposits.

In Section F (conductors) the intermittent and overload ratings of buried cables continue to receive attention, the data collected from power-station engineers being included for analysis. Recommendations have been drafted dealing with the rating of cables used on ships. The research on overhead lines has progressed as far as deflection and performance tests of standard "A" and "H" poles, inserted to various depths. In this research, the records were made with the aid of a kinema camera, which enabled a detailed examination of the behaviour of the poles to be made at leisure. This research is in the report stage, and the tests of long overhead lines are being pushed.

Section G (electric control apparatus) deals with the phenomena of switching and arcing, mining switchgear, heavy-duty fuses, d.c. circuit-breakers, and the resistivity of joints and contacts. The investigation of the phenomena of switching and arcing has involved as a preliminary the determination of the short-circuit characteristics of a large alternator at Carville power station, the development of devices for predetermining the instant at which a circuit is made or broken, and special apparatus for controlling the power factor and energy flow. An adjustable switch has been designed and constructed. Pending the completion of arrangements on the site of the test, there has been made a critical survey of all available data on switching and arcing.

The tests on mining switchgear deal chiefly with the pressures developed in closed chambers; satisfactory workshop tests have been devised. The investigations on heavy-duty fuses have progressed, with the aid of tests on a large battery under short circuit conditions, to a point where test methods can be formulated. It yet remains to test makers' samples, of which a complete set has been collected. Preliminary tests of d.c. circuit breakers have disclosed unexpected difficulties in the determination of the physical constants of shorted circuits. When these have been overcome, it is hoped to secure the loan of apparatus suitable for large-scale tests, failing which it will be necessary to fall back upon the special apparatus built for the researches on switching and arcing.

A close study has been made by the committee of Section K of the whole question of the production in this country of synthetic resins. The scope of this work includes plans for the supply and production of raw materials, for test methods, and the collection of samples for tests. A report is expected shortly.

The activities of Section L, formed to deal with dielectrics in general, have resulted in an extensive programme of research on dielectric losses to be carried out in co-operation with the N.P.L. This will commence with observations at low voltages and at low and audio frequencies, and will later proceed to the development of test methods for high voltages and radio frequencies. The experimental work on the thermal resistivity of dielectrics in sheet form is proceeding; test methods for built-up insulation have been developed, and are to be used in investigating various methods of construction.

The researches on condenser corrosion and on turbines, carried out in co-operation with other research associations, have reached the report stage. The report on the corrosion of metals is a most valuable *résumé* of several years' investigations, and should go far to remove much of the guess-work hitherto inevitable in condenser maintenance and design.

REVIEWS.

Automatic Telephone Systems. By William Aitken, M.I.E.E., A.Am.I.E.E. Pp. xv+282; figs. 208. London: Benn Brothers, Ltd. Price 25s. net.

It is a distinct boon to students of telephony, as well as to telephone engineers themselves, when the complete subject of automatic telephony is so satisfactorily set forth as it is in the present volume.

Recognising the intricacies of the various systems now in vogue, the author has extracted the essential features of each and presented them in such a way that it would be difficult to suggest an equally satisfactory alternative method. The object of the work is, as the author says in his preface, "the making of this most complex subject intelligible to anyone having some electrical knowledge, and that, not by writing down to the learner or giving scrip diagrams for each feature, but by rearranging the diagrams, eliminating unnecessary crossing lines, simplifying the form, and dividing them into sections where necessary or continuing them section by section in such a way as to show the relationship and interconnection of the system as a whole."

In this and the succeeding volume the whole field of present-day automatic telephony will have been covered. In addition, the author keeps the outlook from the inventor's standpoint in view by giving particulars of systems which are not well known, but which it is reasonable to believe may yet come into use, and one of the aims of the book is to indicate the possible direction of future development.

The systems described in the present volume are those of the "Strowger" as represented by the Automatic Electric Co., Chicago, and the Automatic Telephone Manufacturing Co., Siemens Brothers' system, the Western Electric Co.'s systems—rotary and panel, the Relay Automatic Telephone Co.'s system, and the system of the Coventry Automatic Telephones, Ltd. The treatment of the whole is such that it would be difficult to single out any one portion for special commendation where all is good; but the description of the Western Electric Co's. panel system—a system which is about to be tried by the British Post Office in G.P.O. South—may be selected as typical, and although the author is unable to give complete circuit diagrams of the Commercial system circuits, he makes good the deficiency by reproducing the diagrams of the patent specifications, leaving whatever modifications may subsequently be necessary to be dealt with in the second volume.

One of the most arresting features of the work is the series of excellent diagrams and illustrations, of which there are no fewer than 211 interspersed throughout the text, all of which are drawn to a scale that enables the associated descriptive matter to be easily followed.

At the end of the volume a glossary is given of standard terms and definitions used in automatic telephony, which has been arrived at by agreement with the American Engineering Standards Committee.—A.F.

Boiler Inspection and Maintenance. By R. Clayton. Pp. 118; illustrated. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

The object of this technical primer is to give the reader a clear insight into modern practice in the maintenance, overhaul and inspection of the most usual types of boilers and accessories met with in steam power plant.

The author does not claim to have treated the subject comprehensively, but in the limited space at his disposal he has clearly set forth the principal features in connection with the safe, efficient, and economical supervision of boiler-house plant.

Some useful notes are given on types of plant and accessories, followed by a couple of chapters on Lancashire boilers. The Lancashire boiler is taken as a fundamental type, and some 15 pages are devoted to remarks on construction and the various defects which may arise in working, such as wasting, corrosion, pitting and grooving, and the probable location of these troubles. Notes are given on such practical matters as boiler and flue cleaning, the maintenance of valves and fittings, and the efficient upkeep of this type of boiler.

The Cornish, Galloway, and other types of internally-fired boilers are briefly described, and possible defects are touched upon, but the space devoted to other types of cylindrical boilers such as the dry and wet-back marine patterns is somewhat scanty, and the lack of illustrations is rather disappointing.

The Babcock boiler naturally receives important mention, and an illustration of the marine type is given on p. 62, whilst notes on defects likely to arise with this class of boiler are given in the text. The Woodeson and Stirling types are mentioned, and it is refreshing to find that the author believes that some of the more unconventional designs of water-tube boilers will be encountered more in the future.

It would be quite interesting if the present monopoly in water-tube boilers could be effectively countered, and we had some really progressive designs tried under large scale conditions in this country.

Vertical and other types of small capacity boilers are considered, and constructional and service defects are touched upon, whilst an illustration of the well-known Cochran boiler is included.

Some 13 pages are devoted to economisers and superheaters and much useful information is given by the author with regard to maintenance. On page 87 the author states that economiser safety valves should be set to blow-off at about 20 lb. above the nominal blow-off pressure of the boiler, but whilst this may avoid stresses on the economiser it will generally result in trouble from valve lifting, and a higher setting is usually desirable even where centrifugal type feed pumps are installed. Steel tube economisers are touched upon, and their liability to excessive internal corrosion and external wasting is rightly emphasised.

Finally a chapter is devoted to the supervision and maintenance of miscellaneous equipment in the boiler house, and the numerous points which demand attention from time to time are briefly dealt with in the limited space of some 16 pages.

The book is lucidly written and the author has been careful to avoid advanced technical terms, so that the handbook can be confidently recommended to students, mechanics, and others connected with the operation and maintenance of boiler plant, although the value of a work on such a practical subject would probably have been enhanced by the inclusion of further illustrations.—L. M. J.

The Book of the Ford Electrical Equipment. By R. T. Nicholson, M.A. Pp. 148; figs. 84. London: Temple Press, Ltd. Price 3s. net.

The present-day model of the universal Ford car includes an electrical starting and lighting outfit on what may now be called standard lines. That is to say, it is a two-unit system, the generator being driven by skew gearing from the timing wheel, and having its output controlled by the well-known third-brush method, while the starting motor is connected

to the engine when required by the ingenious Bendix pinion. Curiously enough the special fly-wheel magneto is still retained for ignition, and for the horn. The book under review is intended as a practical guide for the average Ford owner with a non-electrical mind to the new lighting and starting system, which incidently supplies current to the ignition system for starting. Since the fly-wheel magneto is retained and intended to be used for general running, we think that the description and instructions concerning it should have certainly been included in the present book, purporting to deal with the Ford electrical equipment. In place of this, whenever the magneto is mentioned, the author refers us to his "Book of the Ford." Having had this one grumble, we may pass on to say that on the whole the book, which is in effect a magnified instruction book on this one system, fulfils its purpose remarkably well. The author evidently knows his subject thoroughly, as we might expect from one who has written two other Ford handbooks.

Illustrations are freely supplied and are clear, with the exception of the frontispiece, a point that should be noticed in subsequent editions. A particularly good diagram is given on page 27 to illustrate the function of an induction coil, so difficult to explain to a non-technical reader in a few words. Another good feature is the provision of separate diagrams of each circuit in the chapters dealing with trouble-finding, towards the end of the book. Also, it is pleasing to observe that the author condemns the use of the word "commutator" for the revolving switch used on the Ford to distribute the l.p. current to the four induction coils. He substitutes the word "timer," reserving the word "commutator" for its correct application in connection with the generator and the motor.

The book is divided into 18 chapters, some, however, being so short as hardly to deserve the title, the first chapter for example consisting of one page and others of two or three pages only. The first half of the book consists of a few very elementary facts about electrical principles, followed by full practical instructions about how to use and maintain the apparatus on the Ford car. This part is very well done, and from it the average owner of a new Ford will obtain all the information he is ever likely to require. Then follow several chapters on tracing certain catalogued troubles by means of definite steps lettered from AA to FG. Possibly these may be useful, but troubles when they occur generally seem to have a way of keeping outside the proper list, and following the tabulated steps often seems more difficult than finding the actual fault, in the present writer's opinion at least.

The superhuman task is then attempted of trying to explain in non-technical terms the complete theory of a dynamo and a motor (including third-brush output regulation) all in the space of two very short "chapters." The result is as satisfactory as could be expected, though the slip on p. 142, of describing the field coils of the series wound motor as shunt coils, should have been avoided.

Some of the definitions are rather loose, and the grammar is not always above reproach. For example, p. 72 "Electricity can always be trusted to sort itself out. It does not get tangled up in itself"; p. 128 "the point of which always turns to the north (or so near the north as does not matter)"; p. 141 "This will seem a very crude statement of the facts, but there is really all there is in them." A peculiarity of the book is the continuous use of words and phrases in inverted commas. The repetition of such slang as "any old conductor," "any old stuff," rather gets on the reader's nerves after a time. As a whole the book is sound and practical and will undoubtedly be of great use to the large army of Ford owners.

F. H. H.

Electrical Installation Work, 1921. By J. H. Havelock, A.M.I.E.E. Pp. viii+366; figs. 120. Second edition. London: Crosby Lockwood & Son. Price 15s. net.

In issuing a second edition of this book, Mr. Havelock has done scarcely anything but re-print the first and as there were many points that might have been improved; parts that might have been condensed and omitted; and also questions that, though of great importance, were scarcely dealt with at all, this means the loss of an opportunity for considerably improving the book.

Once elementary points of theory have been considered, the principal subject for a book justifying the title of this one would seem to be a detailed description of the various wiring systems and a critical examination of each to explain its merits and de-merits. All this is, however, scarcely touched on. There is a single tabulated statement, occupying one page, in which the various wiring systems are scheduled with extremely brief remarks about each, but this, of course, does not meet the case at all adequately. On the other hand there are six pages of description of C.T.S. wiring (apparently supplied by the makers of the material). This is hardly a reasonable proportion. One might assume that Mr. Havelock thinks this to be the only system worth real consideration, but this is probably not the case.

On the other hand, nearly a quarter of the book is occupied by a reprint of wiring rules, tables of logarithms, and such like material which, though suitable for a "pocket book," is out of place in a text book. The information can be obtained much more cheaply in other forms.

Apart from the description of C.T.S. wiring, which is new to this edition, there is no real alteration from the first edition. As before the illustrations are clear and have the great merit, for the most part, of having been specially prepared and not simply copied from a manufacturer's catalogue. Possibly, however, some of this space might have been used to better advantage as full and half page illustrations of wall plugs, tumbler switches, and so on are not really necessary.

The best part of the book is that dealing with the practical work. This is well written and should be of considerable value. If the rest of the book were remodelled to correspond, it would be a valuable text book on the subject with which it claims to deal.

The Theory of the Induction Coil. By E. Taylor-Jones, D.Sc., F.Inst.P. Pp. 214. London, 1921: Sir Isaac Pitman & Sons, Ltd. Price 12s. 6d net.

A perusal of the opening chapter of this book makes it evident the author is one who has made the induction coil and its theory a hobby. The introductory chapter opens with a well-written historical account of induction-coil development since Faraday's discovery of induction in 1831. The remainder of this chapter gives the normal description of induction coils and interruptors and a more original summary of theories on the action of the coil. The second chapter defines primary, secondary, and mutual induction and coupling, and then gives the solution of the differential equations for the oscillation transformer, a detailed solution by the Drude method being given in the appendix. This is followed by a simpler theory, in which resistances are neglected. Capacity-potential curves are next dealt with at great length. Chapter V deals with the wave form of the secondary potential and, incidentally the construction and detailed mathematical theory of an electrostatic oscillograph of the author's construction is given, and this instrument should find application to other purposes than those of the author. Further chapters deal with variation in coupling and the determination of the physical constants of the induction coil, and this, together with the chapter on optimum secondary capacity, measurement of secondary capacity, and the maximum primary potential are possibly the most practical portion of the book. Concluding chapters deal with the discharge, the secondary potential at "make," the Tesla coil, and the high-pressure magneto. Appendices deal at length with the mathematical treatment of various problems abbreviated in the text.

Undoubtedly the present book fills the gap which has long been present in induction-coil literature, and it is to be regretted that the author has not treated the matter more from the point of view of coil design, rather than as a purely physical problem.

The treatment from the point of view of the physicist is excellent, and to the physicist it should be of value. Otherwise one might say the only practical interest in induction coils at the present is in connection with wireless telegraphy and X-ray working. As regards the former, the present-day tendency to work the wireless installation from an accumulator battery instead of the vessel's mains, tends to make coil excitation for emergency purposes obsolete, and doubtless the small valve transmitter will eventually entirely displace the present-day emergency induction coil set.

As regards X-ray work, whilst the transformer method of excitation of the tube appeals more to the engineer, there is no doubt that many workers have a preference for the induction coil and, as is well known and has recently been shown by experiments by H. Behnken, the method of induction-coil excitation has definite quantitative advantages. Hence the theory of the coil is likely to still be of considerable practical importance, and this book can be thoroughly recommended both to the pure physicist and to all those engaged in induction-coil design for electro-medical and other purposes.—B. Leggett.

Memorial.—A memorial tablet has recently been erected in an imposing position on the wall of the main entrance to the offices of the St. James' & Pall Mall Electric Light Co., Carnaby Street, Golden Square, W.1. The tablet is of Carrara marble mounted on a dove-coloured marble base—with blue lettering—and is erected in grateful remembrance of 21 employés of the St. James' Co. and four employés of its ally—the Central Electric Supply Co.—who fell in the world war. The memorial was unveiled on Tuesday, January 24th—in the presence of a large number of employés—by the chairman of the St. James' and Central Companies (Mr. Walter Leaf) who in fitting terms referred to the honour and reverence in which the 25 men whose names are recorded on the tablet are held by the directors and employés, and said that the memorial would stand for all time as a monument of gratitude and appreciation. The tablet was designed and erected by Messrs. John Underwood & Sons, of Baker Street, W.1.

Mme. Curie and the Académie de Médecine.—By a substantial majority the Académie de Médecine, on January 24th, agreed to the inclusion of the name of Mme. Curie in the list of candidates for the vacant seat. It is now uncertain whether Mme. Curie, having secured the right of candidature, will consent to stand for election, but if she does her acceptance is considered very probable.

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEXTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

1,320. "Ignition systems of internal-combustion engines." R. W. H. Fox and C. E. James. January 16th.
1,326. "Wireless navigation apparatus." G. P. Grenfell and J. Robinson. January 16th.
1,327. "Telephonic apparatus and installations." C. B. Wardman. January 16th.
1,339. "Means for audibly signalling upon sounds being reproduced in a telephone receiver." F. W. Hampshire. January 16th.
1,345. "Electrical rheumatic spring foot support." L. Ebelman, F. E. Pratt, and C. Saunders. January 16th
1,356. "Insulating sheet materials." Metropolitan-Vickers Electrical Co., Ltd. January 16th. (United States, January 20th, 1921.)
1,358. "Vibratory device for sound signals, &c." H. Baron (Signal Ges.). January 16th.
1,359. "Determining depth of the sea." H. Baron (Signal Ges.). January 16th.
1,360. "Automatic telephone systems." T. Lenaghan. January 16th.
1,363. "Gasfilled electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. January 16th. (Holland, February 10th, 1921.)
1,364. "Commutators or current distributors of electric ignition systems." J. H. Runbaken and W. Torrance. January 16th.
1,381. "Combined electric lampholder and switch for vehicle lamps." A. H. Hunt. January 16th.
1,392. "Automatic switches for control of electrical current." V. A. Keller. January 17th.
1,394. "Portable electrical apparatus for attachment to domestic baths." W. M. Edwards. January 17th.
1,422. "Telephone register." W. M. E. Ryan and J. C. Ryan. January 17th.
1,432. "Combination of dynamo-electric machines to maintain constant load on water wheels, turbines, &c." Drake & Gorham, Ltd., and A. H. St. C. Watson. January 17th.
1,435. "Electro magnetic clutches." J. W. Hall. January 17th.
1,438. "Electrical inductances." C. E. Wheeler. January 17th.
1,442. "Variable electric cordensers." V. J. Hinkley. January 17th.
1,458. "Control of electric motors." E. A. Binney and Metropolitan-Vickers Electrical Co., Ltd. January 17th.
1,459. "Air connections for electro-magnetically actuated valves." J. P. Campbell and Metropolitan-Vickers Electrical Co., Ltd., and N. E. North. January 17th.
1,460. "Electric switchgear." W. A. Coates and Metropolitan-Vickers Electrical Co., Ltd. January 17th.
1,461. "Electric switchgear." W. A. Coates and Metropolitan-Vickers Electrical Co., Ltd. January 17th.
1,463. "Wireless signalling systems." R. Hansen. January 17th.
1,476. "Electric lamps to be carried on the person." G. Oldham and J. Oldham. January 17th.
1,481. "Electric organ actions." H. S. Jones and T. H. S. Jones. January 17th.
1,487. "Electro-plating apparatus." W. H. Anderson. January 17th.
1,488. "Electrical commutator machines." Siemens Schuckertwerke. January 17th. (Germany, January 17th, 1920.)
1,494. "Hot wire microphones." E. T. Paris and W. S. Tucker. January 17th.
1,500. "Electric alarm signals, &c." J. R. West. January 17th.
1,504. "Electric candle lamps." O. T. Banks. January 17th.
1,506. "Incandescent electric lamps." S. L. Price. January 17th.
1,509. "Methods of eliminating currents in lead sheathings of electric cables." A. M. Taylor. January 18th.
1,512. "Device for preventing theft of electrically-propelled vehicles." G. S. Hynes. January 18th.
1,568. "Wireless telegraphy, &c." Radio Communication Co., Ltd., and J. Scott-Taggart. January 18th.
1,574. "Photographic sound recording and light telephony." H. G. Matthews. January 18th.
1,583. "High-frequency telephony." Ges. fur Drahtlose Telegraphie. January 18th. (Germany, February 11th, 1921.)
1,584. "Receiving arrangements for submarine sound." H. Baron (Signal Ges.). January 18th.
1,592. "Apparatus for determining dielectric strength." A. W. Empson. January 18th.
1,599. "Automatic maximum and minimum current circuit breakers." V. Martinetto. January 18th. (Italy, March, 15th, 1921.)
1,609. "Bulb and reflector fittings of electric lanterns, &c." F. W. Thorpe and Veritys, Ltd. January 19th.
1,610. "Electric fuse box." E. A. Claremont and G. H. Scholes. January 19th.
1,611. "Thermal switches or automatic cut-outs for incandescent electric lamps." F. H. Eeles. January 19th.
1,621. "Electrical signalling devices." F. C. Tipping. January 19th.
1,628. "Signal transmitting device for wireless, flashlight, and land-line systems of telegraphy." E. J. Quinn. January 19th.
1,648. "Spring contacts for electric switches, fuse holders, &c." A. C. Smith. January 19th.
1,651. "Electric fuses, cut-outs, &c." Siemens Bros. & Co., Ltd., and H. G. Wood. January 19th.
1,655. "Electric lighting on motor vehicles." W. T. Wilkinson and R. Tilley. January 19th.
1,656. "Message pads for telephones, &c." H. O. Quinn. January 19th.
1,661. "Electric ship propulsion systems." J. P. Campbell and Metropolitan-Vickers Electrical Co., Ltd, and L. Miller. January 19th.
1,666. "Electric relays, &c." W. S. Graff Baker. January 19th.
1,677. "Electric horns, &c." W. Seck. January 19th.
1,696. "Phonometer." C. J. G. Wood. January 19th.
1,700. "Dimming switches." A. T. Padmore. January 19th.
1,707. "Electrically-operated trucks." H. J. Carey. January 20th.
1,714. "Fault localisation for underground electric cables." Callender's Cable & Construction Co., Ltd., and C. W. Kay. January 20th.
1,717. "Suspension chains for electric light fittings." G. Brookes and Brookes, Ward & Co., Ltd. January 20th.
1,730. "Electric projector lamps for advertising, &c." W. Bucklow and L. H. Montague. January 20th.
1,739. "Electric heaters for incubators, &c." A. Wilson. January 20th.
1,756. "Electro-magnetic clutches." J. W. Hall. January 20th.
1,757. "Motor-car head lamps, &c." J. S. Couldrey. January 20th.
1,762. "Electro-mechanical relays." A. E. Mills and K. S. Mills. January 20th.
1,763. "Electric accumulators, &c." W. S. Jeal and M. Payne. January 20th.
1,769. "Potential transformers and fuses used therewith." W. A. Coates, D. R. Davies, and Metropolitan-Vickers Electrical Co., Ltd. January 20th.
1,770. "Electric protective relay apparatus." Metropolitan-Vickers Electrical Co., Ltd. January 20th. (United States, January 20th, 1921.)
1,784. "Mounting commutators of electric machines." Siemens Schuckertwerke. January 20th. (Germany, January 20th, 1921.)
1,785. "Electric switching devices." J. F. Monnot. January 20th.
1,790. "Systems for producing oscillating currents." British Thomson-Houston Co., Ltd January 20th. (United States, May 18th, 1921.)
1,791. "Leading-in wires." British Thomson-Houston Co., Ltd. (General Electric Co.). January 20th.
1,792. "Electron devices." British Thomson-Houston Co., Ltd. January 20th. (United States, August 23th, 1921.)
1,793. "Electron discharge devices." British Thomson-Houston Co., Ltd. January 20th. (United States, July 1st, 1921.)
1,834. "Machines for making coils of insulated, &c., wire." J. F. Sutton. January 21st.
1,838. "Inductance coils for wireless telegraphy, &c." J. F. Sutton. January 21st.
1,840. "Electro-magnetic hammers for bells, &c." A. E. J. Ball and I. H. Parsons. January 21st.
1,847. "Incandescent electric lamp holder." H. W. Rush. January 21st.
1,848. "Radio, &c., telegraphy." E. Pollock. January 21st.
1,862. "Telephone systems." Siemens and Halske Akt. Ges. January 21st. (Germany, January 21st, 1921.)
1,864. "Electric accumulators." H. Leitner. January 21st.
1,865. "Electro-pneumatic relays and sustaining devices therefor." J. H. Compton. January 21st.
1,875. "Electromotive apparatus for track circuit relays or electricity meters." A. E. Angold and F. L. Castle and General Electric Co., Ltd. January 21st.
1,878. "Electric switches." E. G. Harcourt. January 21st.
1,880. "Power-factor measuring or indicating instruments for alternating electric currents." Chamberlain & Hookham, Ltd., S. James. January 21st.
1,891. "Electric control switch." O. S. Corbett. January 21st.
1,897. "Spark intensifiers." J. Froelicher. January 21st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

13,467. "Electric control of railway trains or vehicles." A. R. Angus. July 10th, 1920. (173,531.)

1920.

17,321. "Sparking plugs for internal-combustion engines." P. Mei. June 25th, 1920. (173,535.)
17,334. "Asynchronous electric motors." Siemens Schuckertwerke Ges. March 30th, 1916. (146,175.)
17,335. "Asynchronous electric motors." Siemens Schuckertwerke Ges. January 12th, 1917. (Addition to 146,175.) (146,176.)
17,560. "Asynchronous electric motors." Siemens Schuckertwerke Ges. March 30th, 1916. (146,242.)
18,810. "Electric ignition plugs." Michigan Spark Plug Co. January 31st, 1919. (173,530.)
18,991. "Electric discharge apparatus." F. Schroter. January 23rd, 1918. (147,037.)
20,034. "Electron discharge apparatus." British Thomson-Houston Co. Ltd. October 28th, 1915. (148,132.)
20,236. "Method of tuning direct-coupled transmitting apparatus for wireless telegraphy." Dr. E. F. Huth Ges. and Dr. S. Loewe. September 18th, 1915. (148,322.)
21,725. "Automatic switch which is particularly suitable for electric hoists." A Satterthwaite. July 20th, 1920. (173,549.)
22,013. "Sound producing devices." H. A. Gaydon and Creed & Co., Ltd. July 22nd, 1920. (173,551.)
23,103. "Induction motors." British Thomson-Houston Co., Ltd. (General Electric Co.). August 5th, 1920. (173,556.)
24,690. "Anti-parasitic selecting and receiving system for telegraphy and telephony with or without wires." L. Levy. August 25th, 1919. (Addition to 133,306.) (150,352.)
25,426. "Construction of thermionic valves as used in wireless signalling systems." J. Scott-Taggart and G. G. Farley. September 3rd, 1920. (173,568.)
26,994. "Process for removing gas residues and for purifying inert gases in electric vacuum tubes, incandescent lamps, and the like." Dr. G. Holst, Dr. E. Oosterhuis, and Naamlooze Vennootschap Philips' Gloeilampenfabrieken. September 23rd, 1919. (151,611.)
28,090. "Electric inductance apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). October 4th, 1920. (173,606.)
28,213. "Resistance switches for controlling the intensity of electric currents." J. Watkinson. October 5th, 1920. (Cognate application 2,112/21.) (173,613.)
28,599. "Circuit controlling apparatus suitable for use in wireless telegraphy." F. G. Creed and Creed & Co., Ltd. October 8th, 1920. (173,631.)
28,673. "Sounding apparatus for submarine boats." Electric Boat Co. October 11th, 1919. (152,333.)
28,717. "Power generating units for locomotive headlights." H. E. Elrod and B. B. Lacy. October 11th, 1920. (173,625.)
29,088. "Electric starters for internal-combustion engines." A. H. Midgley and C. A. Vandervell & Co., Ltd. October 14th, 1920. (173,629.)
29,335. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., P. Webster, and R. Mercer. October 18th, 1920. (173,633.)
29,461. "Portable electric lamps." W. H. Shannon. October 19th, 1920. (173,638.)
29,707. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., and J. Savin. October 21st, 1920. (173,641.)
29,731. "Measured service telephone systems." Automatic Telephone Manufacturing Co., Ltd. December 13th, 1919. (155,568.)
29,811. "Distributors for high-tension ignition apparatus." E. A. Watson and M.-L. Magneto Syndicate, Ltd. October 21st, 1920. (173,643.)
30,121. "Electric relays." McKenzie Holland & Westinghouse Power Signal Co., Ltd., and W. A. Pearce. October 25th, 1920. (173,648.)
30,156. "Magnetic circuit of electrical motors and dynamos." H. Robinson. October 25th, 1920. (173,649.)
30,528. "Moisture indicators." British Thomson-Houston Co., Ltd. (General Electric Co.). October 28th, 1920. (173,653.)
30,985. "Thermally controlled circuit interrupters." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). November 2nd, 1920. (173,657.)
31,180. "Electrical heating units." H. Cheshire and V. Summerhayes. November 4th, 1920. (173,660.)
31,235. "Self-acting locking lampholder for incandescent electric lamps when same are inserted." A. J. Barker. November 4th, 1920. (173,661.)
32,003. "Trolley heads for electrically-propelled vehicles." R. J. Danson. November 12th, 1920. (173,669.)
32,247. "Galvanic batteries." O. Oldham, G. Oldham, and J. Oldham. November 15th, 1920. (173,671.)
32,937. "Spark plug." A. A. Thornton (Ignition Co. of America). November 22nd, 1920. (173,674.)
34,560. "Method of controlling continuous current motors." Oesterreichische Siemens Schuckertwerke. January 29th, 1916. (Divided application on 145,589, addition to 145,589.) (154,936.)

1921.

1,243. "Electric connecting plugs." O. Stalhane and O. O. Kring. November 27th, 1918. (157,331.)
4,055. "Portable accumulators." J. W. Cook. February 3rd, 1921. (173,442.)
7,276. "Electric blasting fuses." A. L. Oliver. March 7th, 1921. (173,450.)
11,446. "Control of electrically-operated fluid compressors." Westinghouse Brake and Saxby Signal Co., Ltd. August 31st, 1920. (168,583.)
16,504. "Air removing apparatus adapted for use with mercury vapour rectifiers, and like devices operating with a permanent high vacuum." Siemens Schuckertwerke Ges. June 15th, 1920. (164,756.)
20,287. "Ejectors of the inward flow radial type." Metropolitan-Vickers Electrical Co., Ltd. September 29th, 1920. (169,683.)
23,245. "Condensate ejectors." Metropolitan-Vickers Electrical Co., Ltd. October 22nd, 1920. (170,558.)
23,349. "Electric apparatus for the permanent waving of the hair." G. Boudou. March 26th, 1920. (Divided application on 160,746.) (168,600.)